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ENGINEERING LIBRARY

The Engineer

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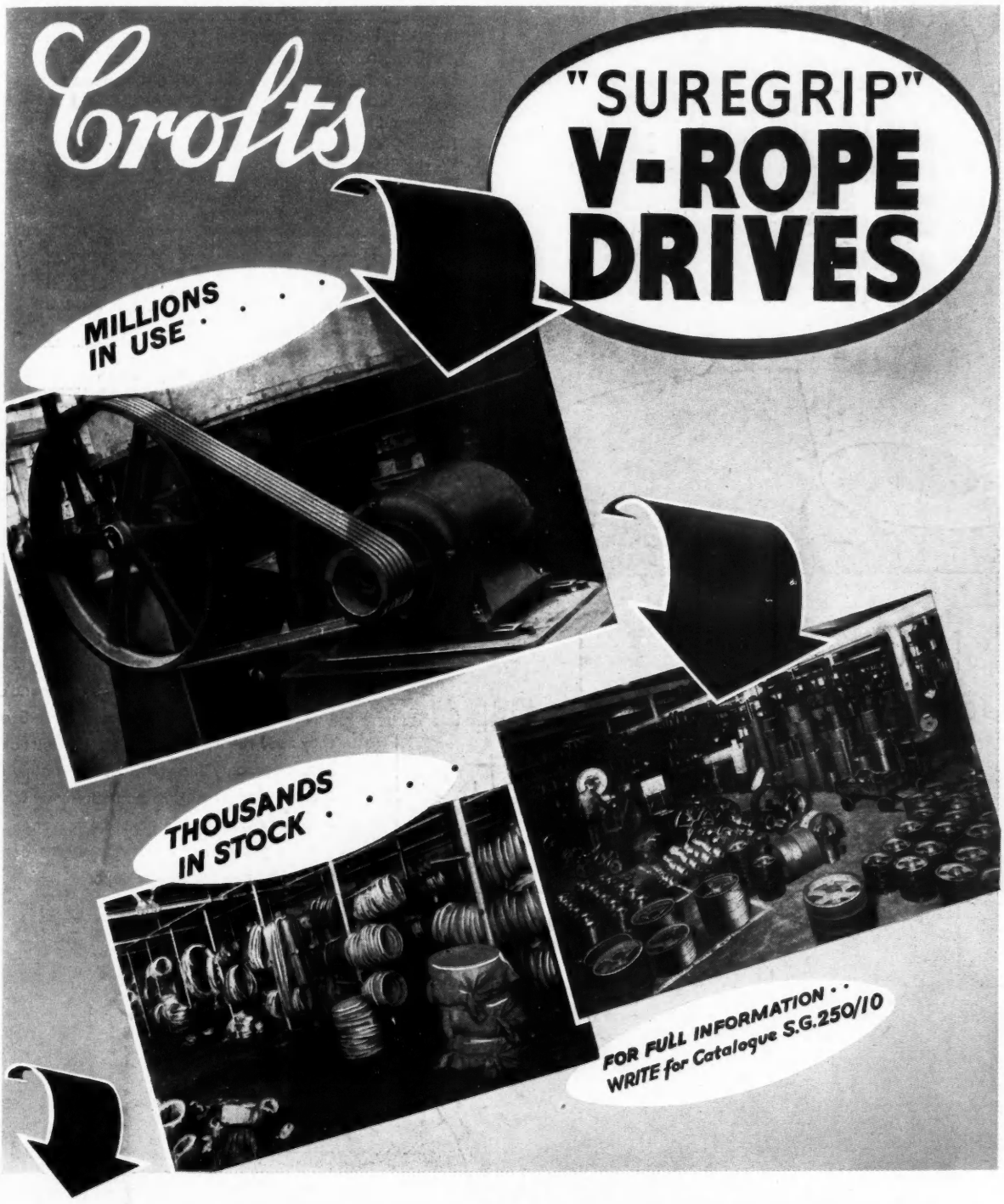

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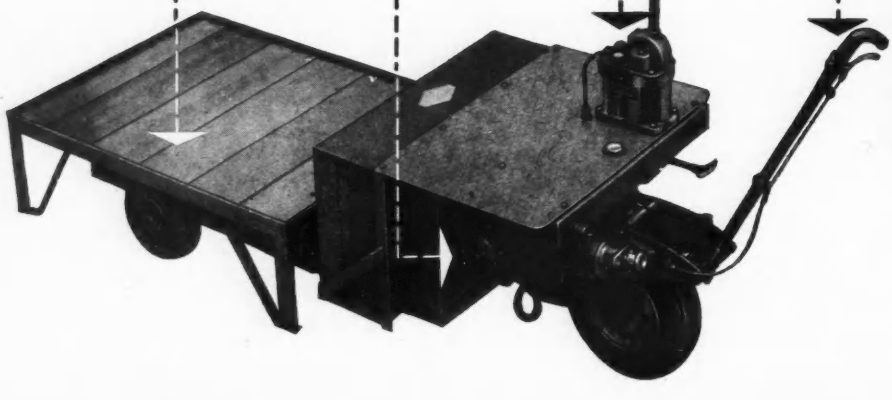
— and economy too

Only 12 inches high, the stillage table gives you an area of more than 10 square feet.

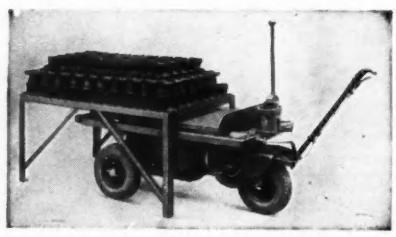
Self-contained power unit contains motor, shock-proof automatic clutch and reduction gear.

A few short strokes lift the loaded platform 4 inches. A simple release valve lets it down again.

This handle controls forward and reverse drive, steering and braking. Little skill is needed.

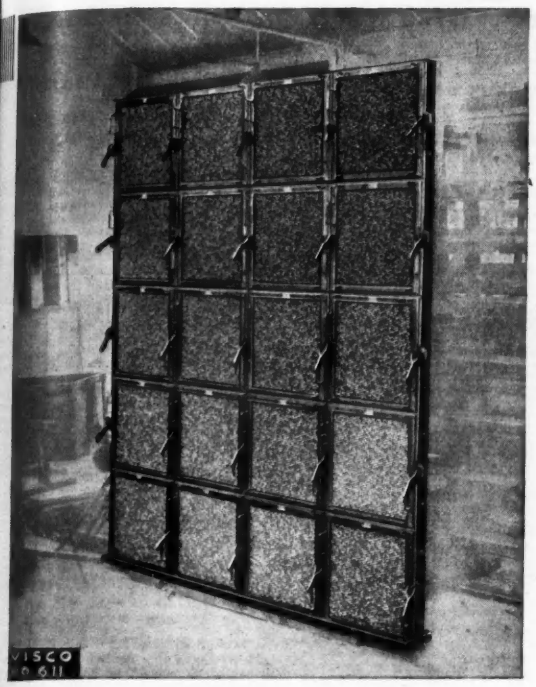


GRAISELEY stillage trucks will carry 20 cwts. at a time, work all day up inclines, round corners and in and out of confined spaces. After 8 or 10 miles they need re-charging with about 4 units of electricity. That's economy for you. At night they simply plug into the charger which automatically switches off when they are ready for the next day's work. Delivery is good at present. May we arrange a demonstration with your nearest service depot ?



For those who prefer a high stillage. The table has an area of 13½ square feet and stands 27 inches high.

DIAMOND MOTORS (WOLVERHAMPTON) LTD. Upper Villiers Street, Wolverhampton. Telephone : Wolverhampton 22951



VISCO
Air Filters

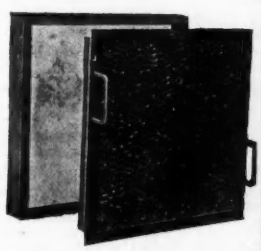
Tens of thousands of "Visco" Air Filters are in regular e in this country and abroad for the ventilation of buildings, ilway coaches, electrical equipment, power stations, etc., d for filtering the intake air of diesel engines, diesel comotives, electric locomotives and air compressors.

For most purposes, our standard all-metal filter of the oil tted type is undoubtedly the most efficient and satisfac- y. This filter consists of metal cells packed with oil-coated gs or ferrules which break up the air into innumerable n streams without producing any undue resistance to e air stream. The dust particles being relatively heavier e thrown against the oil-coated surfaces and retained.

The above illustration shows a panel comprising twenty ndard cells which forms part of an air filtration plant having capacity of 4,800,000 c.f.m. supplied to a Government partment. This, we believe, is the largest air filter in the orld.

-Stage Filtration

egree of air filtration is required, in laboratories, food factories, c., "Visco" two-stage filtration used. The air is first passed rough a set of oil wetted filters d then through dry cell filters.



STANDARD TYPE FILTER

VISCO "DRY CELL" FILTER
SIDE WITHDRAWAL TYPE

Self-Cleaning Filters

For cooling rolling mill motors and other plant operating in very dusty places, as steelworks, "Visco" Patent Rotating Self-Cleaning Filters are in general use.

Consult us on your Air Filtration problems. Ask for "Visco Air Filters," List No. 521.

VISCO ENGINEERING CO LTD. STAFFORD RD. CROYDON

THE ENGINEER

ESTABLISHED 1856

Vol. 195 No. 5060

JANUARY 16, 1953

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PRINCIPAL CONTENTS

(Complete contents on page 100)

Aeronautics in 1952—No. III 91

Civil Engineering in 1952—No. III 82

Electrical Engineering in 1952—No. III 93

Gas Turbines in 1952—No. I 86

The Royal Navy, 1952—No. III 89

Metallurgical Developments in 1952 109

Shipbuilding and Marine Engineering in 1952—No. III 102

Naval Construction in 1952—No. III 110
(RAYMOND V. B. BLACKMAN)

NOTICE TO READERS

All letters intended for insertion in 'The Engineer' or containing questions should be accompanied by the name and address of the writer, not necessarily for publication, but as a proof of good faith. No notice whatever can be taken of anonymous communications. No undertaking can be given to return drawings or manuscripts; correspondents are therefore requested to keep copies.

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WORDING OF ADVERTISEMENTS: Approximately the first 25 letters of each advertisement are set in heavy type. Advertisers are therefore advised to begin their advertisements with the words they want emphasized.

Advertisements received by Mid-day Tuesday will appear in the issue of Friday the same week. Orders must be accompanied by a remittance.

INDEX TO ADVERTISERS—PAGE 119

PUBLIC APPOINTMENTS

UNIVERSITY OF GLASGOW

I.C.I. RESEARCH FELLOWSHIPS IN BIOCHEMISTRY, CHEMISTRY, ENGINEERING, PHARMACOLOGY OR PHYSICS

Applications are invited for I.C.I. RESEARCH FELLOWSHIPS in Biochemistry, Chemistry, Engineering, Pharmacology or Physics, to which some appointments may be made during the current academic year. The appointments will date from 1st October, 1953. The salary will depend upon qualifications and experience, but will be within the range £600–£900 per annum, together with F.S.S.U. benefits and family allowances. Applications (eight copies), with a list of publications and names of two referees, should be sent not later than 28th February, 1953, to the undersigned, from whom further particulars may be obtained.

ROBT. T. HUTCHESON,
E6902 Secretary of University Court.

(AMENDED ADVERTISEMENT)

UNIVERSITY OF BELFAST

LECTURESHIP IN CIVIL ENGINEERING

The Senate of the Queen's University of Belfast invites applications for a LECTURESHIP in CIVIL ENGINEERING, with particular interest in hydraulics, from 1st October, 1953. Salary range £550 by £50 to £1150 with contributory pension rights under the F.S.S.U. Initial placing on the scale will depend on experience and qualifications. Applications should be received by 15th March, 1953.—Particulars from G. R. Cowie, M.A., LL.B., Secretary. E6914

UNIVERSITY OF MELBOURNE
AUSTRALIA

SENIOR LECTURER IN MECHANICAL ENGINEERING

Applications are invited for the position of SENIOR LECTURER in Mechanical Engineering.

Salary, according to qualifications, £A1234–£A1484 per annum (including £234 cost-of-living allowance). Superannuation is similar to F.S.S.U. and policies under F.S.S.U. are transferable.

Further particulars and information as to the method of application should be obtained from the Secretary, Association of Universities of the British Commonwealth, 5, Gordon Square, London, W.C.1.

The closing date for the receipt of applications in London and Australia is 13th March, 1953. E6971

WIGAN AND DISTRICT MINING AND TECHNICAL COLLEGE

HEAD OF THE DEPARTMENT OF MECHANICAL AND ELECTRICAL ENGINEERING

The Governing Body invites applications for the post of HEAD of the DEPARTMENT of MECHANICAL and ELECTRICAL ENGINEERING, rendered vacant by the appointment of Mr. G. E. Cooke, M.A., A.M.I.C.E., to the Principalship of Rotherham Technical College. Duties will commence on 1st April, 1953, or as soon as possible thereafter.

Candidates should possess (a) high academic qualifications, (b) industrial experience, and (c) teaching experience in a Technical College or University. A commencing salary of up to £1340 may be paid to a suitably qualified candidate.

Further particulars and application form will be sent by the undersigned on receipt of a stamped, addressed foolscap envelope. Last date for receipt of applications Monday, 2nd February, 1953. Applications not on the form provided will be disregarded.

E. C. SMITH,
Principal.
7th January, 1953. E6921

CIVIL SERVICE COMMISSION

GOVERNMENT DEPARTMENTS

PROFESSIONAL ENGINEERS

The Civil Service Commissioners invite applications for about 150 pensionable posts in a wide variety of engineering duties. Applications may be accepted up to 30th September, 1953, but an earlier closing date may be announced.

Candidates must be under 35 on 1st January, 1953, with extension for regular service in H.M. Forces and up to two years for permanent civil service. For the Post Office they must be at least 21, for the Ministry of Supply and Ministry of Civil Aviation at least 23, and for all other Departments at least 25 on that date.

Generally a candidate must possess a University Degree in Engineering or be a Corporate Member of one of the professional institutions—Mechanical Engineers, Electrical Engineers, or Civil Engineers—or have passes in, or exemption from, Sections A and B of the corresponding Associate Membership examinations. Exceptionally candidates of high professional attainment, but without the specified qualifications, may be admitted. For some posts Associate Fellowship of the Royal Aeronautical Society or an Honours Degree in Physics will be accepted.

Inclusive salary scale (men in London) £628 (at age 25) to £970. Starting salary according to age up to £875 at 34. Candidates entering below age 25 will start at salaries varying from £429 at age 21 to £549 at age 24. Prospects of promotion. Salaries of next higher grades are £970–£1280 and £1331–£1536. Somewhat lower for women and in the provinces.

Further particulars and application forms from Civil Service Commission, Scientific Branch, Trinidad House, Old Burlington Street, London, W.1, quoting No. S85/53. E6907

PUBLIC APPOINTMENTS

CITY OF LEEDS

WATERWORKS DEPARTMENT

APPOINTMENT OF TECHNICAL STAFF

Applications are invited for the undermentioned appointments :

(a) CHEMIST and BACTERIOLOGIST, A.P.T. Grade IX, £815–£935.

(b) ENGINEERING ASSISTANT, A.P.T. Grade VIII, £760–£835.

(c) ENGINEERING ASSISTANT, A.P.T. Grade VIII, £760–£835.

Applicants for post (a) must have had experience in the bacteriological, as well as the chemical, examination of water.

Applicants for post (b) must have had experience in the design and construction of reinforced concrete water retaining structures and experience in design and installation of rapid gravity filtration works and pumping plants will be an advantage.

Applicants for post (c) must have had experience in the design and construction of large dams.

Applicants for post (a) must have a University Degree and/or other professional qualifications.

Applicants for posts (b) and (c) must be Corporate Members of the Institution of Civil Engineers.

The grading of the posts and conditions of service are in accordance with the A.P.T. Division of the National Scheme of Conditions of Service.

The appointments are subject to the provisions of the Local Government Superannuation Act, 1937.

Selected candidates will be required to pass the Corporation's medical examination.

The persons appointed will be required to devote the whole of their time to the business of the Corporation, and will not be allowed to engage, either directly or indirectly, in private work of any kind.

The appointment will be subject to one month's notice on either side.

Applications, on forms to be obtained from the undersigned, should be delivered not later than 12 noon on Thursday, the 5th February, 1953, endorsed with the description of the post applied for.

Canvassing in any form, either directly or indirectly, will be a disqualification.

KENNETH L. FORSTER,
General Manager and Engineer.
Waterworks Department,
Civic Hall,
Leeds, 1,
12th January, 1953. E6979

THE BRITISH IRON AND STEEL RESEARCH ASSOCIATION

CUTLERY RESEARCH

ENGINEERS

ENGINEERS required for cutlery research in Sheffield. Two vacancies exist in the Cutlery Research Council's team, which is based on the B.I.S.R.A.'s Sheffield Group Laboratories.

The first vacancy is for an engineer with a Degree or equivalent qualification in Mechanical Engineering, and some experience in die and tool design, to carry out research into the forging of small components and development of small mechanisms. Applicants should not be above 30 years of age. The second vacancy is for a junior engineer with National Certificate in Mechanical Engineering to assist in the above activities. Applicants should not be above 25 years of age. Excellent opportunities to collaborate with scientists using the latest techniques and apparatus. Salaries according to age, qualifications and experience. Staff pension scheme. Canteen facilities available.—Apply in writing to Mr. C. N. Kington, B.I.S.R.A., Hoyle Street, Sheffield, 3. E6898

WEST KENT MAIN SEWERAGE BOARD

ENGINEERING ASSISTANTS

Vacancies exist for :—

(a) SENIOR ENGINEERING ASSISTANT, Grade VIII (£760–£25 by 3–£835 plus London "weighting"). Applicants must be Chartered Civil Engineers with experience of sewage purification works and sewerage systems.

(b) ENGINEERING ASSISTANT, Grade V (£595–£15 by 2–£20–£645 plus London "weighting"). Applicants should be Chartered Civil Engineers or have other appropriate professional qualifications, supported by experience of hydraulic or structural engineering.

Applications for these appointments, on forms obtainable from me, should be submitted by Monday, 26th January, 1953.

A. J. W. JEFFERY,
Secretary.
"Barnfield," 20, Blyth Road,
Bromley, Kent. E6917

AIR MINISTRY

WORKS TECHNICAL OFFICER (UNESTABLISHED)

WORKS TECHNICAL OFFICER (Unestablished) required by Air Ministry at Keith, Banffshire, experienced in (i) handling of 33kV. switchgear and split-phase transformers, mercury arc rectifiers, Knowles type electrolytic cells and electrically driven compressors ; (ii) operation and maintenance of high and low-pressure gas distribution systems. Engineer with knowledge of some items plus long experience in electrical matters considered. Salary range £896 to £1055.—Write, giving date of birth, education, full details of qualifications and experience of posts held (including dates), to Appointments Officer, Ministry of Labour and National Service, 1–6, Tavistock Square, W.C.1, quoting E.A.393, by 6th February, 1953. In no circumstances should original testimonials be forwarded. Only candidates selected for interview will be advised. E6970

PUBLIC APPOINTMENTS

BRITISH ELECTRICITY AUTHORITY

SOUTH-EASTERN DIVISION

LITTLEBROOK POWER STATION (480MW)

ASSISTANT ENGINEERS AND STATION CHEMIST

Applications are invited for the following positions :—

(a) MAINTENANCE ENGINEER.

Applicants should be Corporate Members of the Institution of Mechanical and/or Electrical Engineers, or possess an Engineering Degree, with extensive experience in the maintenance of high-pressure turbine and boiler plant, electrical plant and all power station auxiliary plant. Experience in administration is essential.

(b) ASSISTANT ENGINEER (MAINTENANCE)

Applicants should preferably be Corporate Members of the Institution of Electrical Engineers or possess equivalent qualifications. Experience in maintenance of mechanical and electrical plant with particular reference to the maintenance of alternators, switchgear, transformers, electrical auxiliaries, &c., in a large modern power station is essential, as is experience in administration and control of labour.

(c) ASSISTANT ENGINEERS (PLANNING)

Applicants for the above positions should possess sound technical knowledge and be familiar with the operation and maintenance of one of the following :—

(i) Turbines and auxiliary plant, C.W. plant, civil works, cranes and lifting gear and workshops,
(ii) Boilers and ancillary boiler-house plant,
(iii) Coal and ash handling plant, or
(iv) Electrical plant and instruments,

and will be responsible for the control and planning of the maintenance in connection with the above sections of plant.

(d) STATION CHEMIST.

Applicants should possess B.Sc. or equivalent qualification in Chemistry, and have had experience in the analysis and testing of coal and water and in dealing with boiler fouling and water corrosion problems associated with high-pressure and high-temperature steam generating plant. Experience in the control of staff is also required.

(e) ASSISTANT ENGINEER (OPERATION AND EFFICIENCY).

Applicants, who should preferably possess an Engineering Degree or similar qualification, will be required to assist the station operation and efficiency engineer in the examination of station performances and the determination of station operation and maintenance policy, and will be responsible for the control of staff dealing with the day-to-day work relating to station efficiency.

(f) ASSISTANT SHIFT CHARGE ENGINEERS

Technical qualifications equivalent to Graduate Membership of either the Institution of Mechanical or Electrical Engineers. Experience in the efficient operation of modern high-pressure power station plant with P.F. firing essential. Candidates should have had experience in the administration and control of labour.

(g) ASSISTANT ENGINEER (HANDLING).

Applicants, who should possess a knowledge of shipping, coal storage and its associated problems, will be responsible for the operation of the coal and ash handling plant and associated equipment, including mobile equipment. Experience in the control of labour is essential.

(h) ASSISTANT ENGINEER (HANDLING SHIFT)

The successful applicant, who must be capable of controlling labour, will be responsible on shift of the coal and ash handling plant and associated equipment, including mobile equipment.

N.J.B. conditions of service and salary, inclusive of London weighting :

(a) Class M, Grade 6, £1113 p.a.
(b), (f) and (g) Class M, Grade 9, £906 3s. p.a.
(c) and (h) Class M, Grade 12, £740 5s. p.a.
(d) Class M, Grade 7, £1035 6s. p.a.
(e) Class M, Grade 8, £968 2s. p.a.

Applications on forms obtainable from Station Superintendent, Littlebrook Power Station, Nr. Dartford, Kent, should be returned to him by not later than 26th January, 1953. E6968

BRITISH ELECTRICITY AUTHORITY

GENERATION OPERATION

SENIOR ASSISTANT CO-ORDINATING ENGINEER

SENIOR ASSISTANT CO-ORDINATING ENGINEER (Plant Operation) required at Operational Headquarters, London.

Candidates should be Corporate Members of the I.Mech.E. or I.E.E. or have equivalent qualifications. Senior responsibility in management and operation of modern power stations and experience of boiler, turbine and auxiliary plant maintenance is essential. Salary N.J.B., Grade 1, £1002–£1378 inclusive.

Applications, stating age, qualifications, experience and salary, to D. Moffat, Director of Establishments, British Electricity House, Winsley Street, London, W.1, not later than 2nd February, 1953. Quote ref. AE/310. E6932

SOUTHERN ELECTRICITY BOARD

SENIOR DRAUGHTSMAN (CIVIL ENGINEERING)

No. 1 (Southall) Sub-Area Office. Salary N.J.B. Schedule D, Grade 5 (£595 7s./£704 11s. per annum, inclusive of London allowance). N.J.B. Conditions of Service.

Applicants should have had training and experience in building construction and the design of steelwork and reinforced concrete structures, and be capable of preparing drawings and making calculations.

The successful candidate will be required to contribute to the B.E.A. and Area Board's superannuation scheme, if eligible.

Applications, on forms obtainable from the Sub-Area Secretary, 2/6, Windmill Lane, Southall, Middlesex, and returned to him in envelopes suitably endorsed not later than January 26, 1953. E6944

PUBLIC APPOINTMENTS

WELSH REGIONAL HOSPITAL BOARD

ENGINEER'S DIVISION

ENGINEERING ASSISTANT (MECHANICAL)

Applications are invited for the following p in the Engineer's Division :—ENGINEERI ASSISTANT (Mechanical). Salary in accorda with scale £420 by £20 to £600 per annum. starting point being subject to experience. M starting salary £500.

Applicants should have had a sound techn training in mechanical engineering and practi experience in preparation of plans, designs a calculations for heating, hot water supply and ve lating systems.

Applicants must have obtained the Ordin National Certificate in Mechanical Engineering an equivalent qualification). The appointment superannuable and is terminable by one month notice on either side.

Applications, stating age, experience, qualificatio and present position, together with the names a addresses of two referees, should be addressed to Secretary, Welsh Regional Hospital Board, Temple Peace and Health, Cathays Park, Cardiff, so as reach him not later than ten days from the appearan of this advertisement. E6911

BRITISH ELECTRICITY AUTHORITY

GENERATION (PLANT DESIGN)

ENGINEER-IN-CHARGE

British Electricity Authority, Generation (Pla Design) Sub-Branch. ENGINEER-IN-CHARGE General and Co-ordination Section required at Hea quarters, London. Duties will be to take charge of section of specialist engineers dealing with the tech nical and economic aspects of certain ancillary equi ment in power stations, including pipework a valves, instrumentation and controls and fir fighting equipment ; also to collaborate, for co ordination purposes and with responsibility for th final draughting of collective reports, with the engi neers-in-charge of four other specialist section dealing respectively with boiler plant, turbine, con densing and feed heating plant, electrical plant an mechanical handling plant. Candidates should pr ferably have an Honours Degree in Engineering an wide general knowledge of large power station plan practice ; specialised knowledge of any particula branch is not necessary. Salary not less than £15 inclusive.

Forms from D. Moffat, Director of Establish ments, British Electricity House, Winsley Street, W. to be returned by 2nd February, 1953. Quote refe ence AE.307. E6901

BRITISH ELECTRICITY AUTHORITY

GENERATION CONSTRUCTION

PRODUCTION INSPECTION AND TEST ENGINEER

PRODUCTION INSPECTION and TEST ENGINEER required in the Generation Construction Sub Department at Headquarters, London. The suc cessful candidate will be responsible through the Generation Construction Engineer to the Deput Chief Engineer (Construction) for the administration of the production inspection and test organisation o the Authority, both at Headquarters and in seve Regional Offices throughout the country. Candi dates should have wide experience of modern large scale industrial production methods and procedure for the inspection and testing of large items of plan and Corporate Membership of a related Engineering Institution or equivalent qualifications. Preferenc will be shown to candidates with knowledge of the manufacture of the main plant items associated with large modern power stations. Salary within pro visional range £1500–£1750 inclusive.

Applications, stating age, qualifications, experience present appointment and salary, to D. Moffat Director of Establishments, British Electricity House Winsley Street, London, W.1, by 2nd February, 1953 Quote reference AE/312. E6937

NATIONAL COAL BOARD

CENTRAL RESEARCH ESTABLISHMENT

SCIENTISTS

National Coal Board invite applications for super annuable appointments as SCIENTISTS at the Central Research Establishment, Isleworth, Middlesex. Applicants should have an Honours Degree (or equivalent) and a good knowledge of at least one of the following subjects : physical metallurgy, engineering metallurgy (including knowledge of machinery, tool materials, hard metals, &c.), physical chemistry, corrosion.

Appointments will be as either Scientist, Grade II (salary scale £645 by £30 to £1095 per annum), or Scientist, Grade III (salary scale £445 by £25 to £645 per annum), according to qualifications and experience. London location allowance is payable in addition.

Write, giving full particulars (in chronological order) of age, education, qualifications and experience (with dates), to National Coal Board, Establishments (Personnel), Hobart House, Grosvenor Place, London, S.W.1, marking envelope TT/578. Closing date 9th February, 1953. Original testimonials should not be forwarded. E6893

THE ENGINEER

JANUARY 16, 1953

Foundries and the Iron and Steel Bill

IT was stated on Tuesday last that agreement had been reached between the Minister of Supply and the relevant employers' and trade associations on the position of iron foundries in relation to the supervisory board which it is intended to establish under the provisions of the Iron and Steel Bill. Since the Bill was presented, there has been some opposition to the proposal that all iron foundries should be brought within the purview of the board to be set up by the terms of the Bill. A statement on the subject by the Ministry of Supply, following last Tuesday's conversations, said that, whilst the Government adhered to its decision to include the foundries in the Bill, the Minister's intention is to introduce certain amendments to implement the assurances given during the debate on the second reading of the Bill. These amendments, it should be explained, are designed to ensure that the proposed board's powers are limited to those strictly needed for the performance of its duties, and to avoid any unnecessary encroachment into the affairs of the engineering industry.

Engineering Maintenance in Iron and Steel Works

THE British Iron and Steel Research Association has issued this week a summary of the proceedings at a conference, which it held in December, on the subject of engineering maintenance in iron and steel works. The conference was attended by 129 representatives of the iron and steel industry and of the suppliers of the industry's plant. It was held as a direct result of the report of the iron and steel productivity team, five of the members of which were present, including Sir Charles Goodeve, the leader of the team. Opening the conference, Sir Charles suggested that if maintenance was to be carried out with the maximum economy it was necessary to arrive at some means of expressing the cost of down time plus the cost of maintenance per ingot ton. The reasons that American maintenance results frequently made a better showing were, he thought, probably newer plant in American iron and steel works and a little more foresight in the layout of the plant. Other papers presented at the conference were by Mr. Basil Gray, of English Steel Corporation, Ltd., on "Plant Recommendations for the Future"; by Mr. A. Bridge, of the Appleby-Frodingham Steel Company, on "The Relation of Production and Maintenance Departments"; by Mr. G. Oram, of the same company, on "Preventive Maintenance," and by Mr. J. Wadsworth, of Park Gate Iron and Steel Company, Ltd., on "Engineering Maintenance." In this last paper it was pointed out that in the iron and steel industry of this country approximately 30 per cent of the total employees were engaged on maintenance, and their wages represented about 40 per cent of the total maintenance costs. It was suggested that engineers should pay more attention to the manning problem, as much could be done towards improving efficiency and reducing costs if the right people were available to organise, supervise and carry out the maintenance work.

The British Standards Institution

THE British Standards Institution has announced that at the end of the summer it will move in to a single, self-contained office block at 2, Park Street, Mayfair, W.1. It is more than fifty years ago since the British Standards Institution—or the Engineering Standards Committee, as it was then called—occupied its first office at 28, Victoria Street, Westminster. To-day, the Institution occupies seven floors of that building and the adjoining building. It also occupies extensive accommodation at 24, Gillingham Street, near Victoria Station. The Institution's new home in Park Street will be known as British Standards House, and although the floor space is not substantially greater than that at present occupied by the B.S.I., the concentration of staff and facilities under one roof will undoubtedly aid efficiency and economy. There will also be available accommodation for all the 3800 committee meetings which the Institution convenes in the course of a year. It is therefore confidently believed that the new building will provide not only an appropriate and dignified headquarters, but will also enable the British Standards Institution's services to be more efficiently operated in the interests of its members and of industry in general.

A Specialist Team on Industrial Engineering

ON Thursday, January 15th, the first specialist team on industrial engineering to visit the United States sailed in the "Queen Mary." The team, consisting of some thirteen members, is led by Mr. W. F. Garnham, general works manager of Ransomes, Sims and Jefferies, Ltd., and was nominated by the Institution of Production Engineers, the Engineering and Allied Employers' National Federation, the British Institute of Management, the Department of Scientific and Industrial Research, the Institute of Cost and Works Accountants, the Ministry of Education, and the Trades Union Congress. Technical assistance for the visit has been given by the Mutual Security Agency, which will also defray the dollar costs and the British Productivity Council has been responsible for the final arrangements following the early negotiations by the Anglo-American Council on Productivity. In the reports of the preceding sixty-five teams it has been emphasised that, in contrast with most British firms, members of American firms are keen to improve manufacturing methods. This latest team is to discover reasons for such an urge and how it becomes effective and is not concerned with manufacturing details and techniques. The keyword of the team is "methods," and it will study how new knowledge and new ideas are applied and will investigate the sources of the dynamic and aggressive attitude to change, so apparent throughout American industry. The team's terms of reference cover the study of how the process of constant betterment is influenced by budgeting and costing, also administrative organisation and the policy towards personnel, what improvements are effected in factory floor routine, what is the effect of manufacturing demands upon design, and what are the training facilities in industrial engineering.

Fundamental Techniques in Transport

IN the course of his paper entitled "Fundamental Techniques in Transport and Their Recent Evolution," read before the Institute of Transport on January 12th, Monsieur Louis Armand, the Directeur-General, Société Nationale des Chemins de Fer Francais, said that his theme concerned the far-reaching and rapid changes of all factors in the twin fields of economics and technical advancement, so that evolution in transport has been accelerated, confused and slow to adjust itself correctly. He considered the economic structure of industry and how it was affected by modern technical development. Of the various forms of transport the impact of public authority has been mainly on the railways, which carry, measured in ton-miles, 80 per cent of the traffic in France and 90 per cent in the U.S.A. Competition in transport operates under abnormal conditions and development is conditioned by very different economic circumstances. Monsieur Louis Armand touched upon the new devices designed for certain types of traffic, the appearance of individual low-power transport, and the effect of new techniques. He thought that the change from "right to transport" to "obligation to transport" was serious and would be a cause of increasing financial difficulties, and noted that traffic peaks continue to increase. Improved transport productivity was reviewed and also the problem of indirect capital expenditure which the expansion of modern techniques had raised to the highest importance. The author considered various examples of the speed of technical development and pointed out that control was needed to avoid dangers. In looking to the future, he insisted that the necessity of having a directing organisation was independent of the political structure of the industry and had something to say regarding the study of operating costs and planned capital expenditure. In conclusion Monsieur Armand put forward two simple ideas concerning development on a basis of actual working costs and fixing in advance a zone of activity by using capital credits as an intermediary. If we did not know how to provide for the future, the difficulties arising twenty-five years ago out of rail and road competition would, he thought, become general, and precise economic laws would help technical progress to recapture its value whatever the force of its expansion.

National Coal Board's University Scholarships

THE National Coal Board is offering 100 university scholarships in mining engineering and allied subjects to boys from school who have reached a high standard in the General Certificate of Education or the Scottish Leaving Certificate; to young men already in the industry who have university entrance qualifications, and to certain graduates who wish to extend their qualifications for posts of high technical responsibility in mining. This is the sixth year in which the Board has offered these scholarships which cover the whole cost of education and carry maintenance allowances which may amount to more than £300 a year, with extra allowances for married men. Application forms, which must be returned by April 15th, are obtainable from the Board's Education Branch at Hobart House, Grosvenor Place, London, S.W.1. The chairman of the National Coal Board, Sir Hubert Houldsworth, has said recently that one of the factors limiting the rate of capital expenditure in the industry was a shortage of first-class technicians capable of planning and carrying out the necessary new projects and reconstructions. The scholarship scheme is one way of helping to make good the shortage of personnel of that calibre. It is stated that forty-one scholarship winners graduated in 1952 and went into the coal mining industry or carried on research at the universities. Nineteen of them were already in the industry when awarded scholarships and the remaining twenty-two came direct from school. After graduation the students normally do three years' directed practical training in the industry, though a few last year who had had considerable experience in the industry before going to the university, went straight to responsible jobs.

Civil Engineering in 1952

No. III—(*Concluded from page 44, January 9th*)

AN important event of 1952 for the North of Scotland Hydro-Electric Board was the opening of the Mullardoch–Fasnakyle–Affric scheme, one of the major schemes of the Board's early programme of works. The scheme will produce about 236 million units of electricity each year, and it consists principally of two reservoirs each formed by a gravity dam, and connected together by a tunnel, with diversion works leading to a large power station with an installed capacity of 66MW. The smaller dam of the scheme was illustrated in Plate I last week, but the reader should refer to THE ENGINEER of April 11, 18 and 25, 1952, for a full description of the scheme, and to our issue of October 17th last for an account of its inauguration.

From the technical point of view, two announcements of the adoption of interesting trends in hydro-electric practice were made by the Board during the year. They both concern the Moriston project work on the upper part of which was in hand during 1952, contracts having been placed with the Mitchell Construction Company, for the Loyne dam and tunnel, Cluanie dam and Ceannacroc tunnel and generating station. In the upper part of the scheme, a catchment area of 74·5 square miles will be developed with a total plant installation of 20·84MW to give an estimated annual output of 66,000,000 units. Both dams are to be gravity structures and both of them will incorporate precast concrete facing blocks to form both temporary shuttering and permanent facing. In addition, wet-ground blast-furnace slag is to be used to replace about 70 per cent of the cement which would otherwise be required for the concrete of the dams. This expedient —the Trief process—has been used at Bort dam in the French Massif Centrale, and its adoption was noted in our issue of May 9th last. Ceannacroc power station is to be built underground, near the foot of a high-pressure shaft, following a Continental trend of recent years, with a considerable saving of steel and cement. A second underground power station will be built in the lower part of the scheme, as noted in our issue of September 5th last, when the effect of these modifications on the Moriston scheme was described. By the end of the year, work had been started on the construction of camps and workshops, on excavation at Cluanie dam, and on driving the Loyne and Ceannacroc tunnels. Cluanie dam will be the larger of the two dams, with a maximum height above foundations of 125ft and a total length of 2165ft.

The Garry project in Inverness-shire is in two stages—the upper or Quoich works and the lower or Invergarry works. Both stages were under construction in 1952. When complete the project will have an installed capacity of 42·54MW and an estimated annual output of 168·4 million kWh. The Quoich dam, which forms the main storage reservoir, will be a rock-fill structure with a reinforced concrete upstream sealing membrane. Rock fill for the dam will be obtained from a quarry near the dam and from the Quoich tunnel excavation, and will be placed in the dam in layers 2ft thick, consolidated mechanically and washed with water to obtain the maximum compaction. An upstream membrane was adopted in preference to a central core wall so that the maximum structural use could be made of the fill ; it was also considered that any maintenance required on the dam would be simplified. The membrane will be formed of reinforced concrete slabs 20ft by 20ft by 15in thick at the deepest section of the dam and 12in thick elsewhere. The joints between the slabs will be sealed by copper strips filled with a bituminous compound and are designed to accommodate the movements anticipated in the rock fill. The Invergarry dam will be a mass concrete gravity dam incorporating a Borland hydraulic elevator fish pass. The construction of Quoich dams (there are two subsidiary mass concrete dams at low points in the reservoir) and tunnel is being carried out by Richard Costain, Ltd. Excavation of soft material overlying the rock at the main dam site was in progress in 1952, and cofferdams for the river diversion were under construction. A total of 2382ft of the low-pressure portion of the tunnel was driven and 1147ft of the high-pressure section. The contractor for the Invergarry section is Whatlings, Ltd., and the work on this section was at about the same stage, with just over 5000ft of tunnel driven altogether.

The consulting engineers for the three schemes mentioned above—Affric, Garry and Moriston—are in each case Sir William Halcrow and Partners for the civil engineering, and Messrs. Kennedy and Donkin for the mechanical and electrical work.

Recent trends in the design of dams are evident from the various works now in progress for the North of Scotland Hydro-Electric Board. The use of blast-furnace slag in a gravity dam and the construction of a rock-fill dam were mentioned above. Three interesting buttress dams were also under construction in 1952. The main dam of the Shira scheme, for which the consulting engineers are Messrs. Babtie, Shaw and Morton, will be a roundhead buttress structure, 2250ft long and 130ft in maximum height. Excavation was substantially complete by the end of 1952, and a start was made with the concreting, which will be in full swing this year. The two other buttress structures are the Lawers and Errochty dams.

The mountainous area of Ben Lawers, near Loch Tay, in Perthshire, presents favourable features for hydro-electric development. The average annual rainfall of the area is about 87in and a suitable high-level dam site exists at the outlet of the Lochanna-Laraig, some 1600ft above sea level. Construction work on Lawers project was well started in 1952. It comprises a major massive buttress dam, 1100ft long and 135ft maximum height. The dam is founded on Ben Lawers phyllites. The buttresses are to be at 55ft centres and each 22ft wide. A low-pressure steel pipeline, 7ft 6in in diameter and 1460ft long, will lead the water to a concrete lined rock tunnel, 11,750ft long and about 8ft in equivalent diameter, and steel-lined for the last 620ft at the outfall end, where the rock cover is inadequate to withstand the water pressure in the tunnel. The valve house is to be situated immediately downstream of the tunnel outfall and houses a 7ft diameter butterfly valve, the surge shaft being 3280ft upstream of the valve house and 15ft in diameter. A single high-pressure pipeline reducing in diameter from 7ft at the top to 5ft at the power station and 5040ft long will be supported on reinforced concrete saddles at intervals of 48ft throughout its length, and anchored at intervals by massive concrete blocks. The maximum working pressure on the pipeline will be 650 lb per square inch.

Construction of Errochty Power Station

A 30MW Pelton machine will be installed in the power-house, the tail-race from which discharges into Loch Tay at a mean level of 349ft O.D. The natural catchment area collected will amount to 1·7 square miles, and this will be increased by collecting a further 15·8 square miles by small unlined rock tunnels and surface collecting aqueducts. By reason of the high altitude and the incidence of winter snows the latter are to be covered throughout.

Lawers project, with a gross head of 1362ft, will have the highest head of all the North of Scotland Hydro-Electric Board's

developments and will yield an annual output of 80,000,000 units. The principal civil engineering works are being carried out by the Cementation Company, Ltd., valves and gates by Glenfield and Kennedy, Ltd., and the steel pipeline by P. and W. Maclellan, Ltd. The generating plant is to be supplied by British Thomson-Houston Company, Ltd., and Boving and Co., Ltd. The consulting engineers are Messrs. James Williamson and Partners and Messrs. Merz and McLellan.

On the Board's Tummel-Garry project the stage II work was in full progress in 1952, to provide for a power station at the head of Loch Tummel with an installed capacity of 75MW, operating under a gross head of 610ft. Concreting of the buttresses of the multiple buttress dam, 130ft high and 1300ft long, in the Errochty Valley, was in progress, while the Errochty power station was nearly ready for the installation of plant. The illustration shows the spiral casings for each 25MW machine and was taken last June. About 10 miles of tunnel have been driven in connection with this project and lining of these tunnels was proceeding during the year.

On the Glascarnoch - Luichart - Torr Achilty project, which is designed to develop the resources of the Conon basin area in Ross-shire, good progress was made with the construction of the Torr Achilty dam and power station, and also the Luichart dam, tunnel and power station. It is hoped to have power available from Luichart power station (installed capacity 24MW) in about a year's time. Further contracts, comprising tunnels, dams and power stations for the Glascarnoch and Achanalt power stations were let during the year. The civil engineering consultants for this scheme and for the Tummel Garry scheme are Sir Alexander Gibb and Partners, the electrical and mechanical consultants being Messrs. Merz and McLellan.

A Water Supply Scheme

As an example of a reservoir built for water supply and not for power production, the accompanying illustration shows the progress of the Usk reservoir. Work on this reservoir, which is under construction for the Swansea Corporation, with a capacity of 2715 m.g. and comprising an earthen embankment approximately 470 yards long and 110ft high, has now been proceeding for nearly three years. The diversion tunnel, excavation of the cut-off trench into glacial drift and red sandstone, concreting of the cut-off wall, and cement grouting of the red sandstone, were all completed by the end of the year. Good progress was made on the clay puddle core and the embankment filling. The supply tunnel, 1½ miles long, had been driven, and lining with concrete was in hand. This work is being carried out under contract by Richard Costain, Ltd. The delivery of 30 miles of steel pipes by Stewarts and Lloyds, Ltd., began in June, 1951. The pipe-laying contract was awarded to Richard Costain, Ltd., who commenced work in March, 1952, and had laid 4 miles of pipeline by the end of the year. The contract for constructing the treatment works at Graig Fawr, about 10 miles from the reservoir, was also placed with Richard Costain, Ltd., who will be starting work early this year. An order was placed in 1950 with the Permutit Company, Ltd., for filtration plant to deal initially with 8 m.g.d. The engineers for the scheme are Messrs. Binnie Deacon and Gourley. The accompanying illustration, taken last August, gives an aerial view of Usk reservoir, showing the concrete cut-off wall, clay puddle core and embankment filling.

Tunnels

Two examples of the many tunnelling works in progress during 1952 are given here. They describe some difficult work carried out for the construction of a large sewer in the Manchester area, under the direction of the city engineer and surveyor of Manchester, Mr. R. Nicholas, and a progress note on the Woodhead tunnel.

The construction of the Middleton connecting sewer, which conveys sewage from the Borough of Middleton and a number of new housing estates in North Manchester to Manchester Corporation's main drainage system, was completed in March, 1952. The work was commenced in 1946 by tunnelling in free air, but was suspended in 1947, when some 700 yards of sewer had been constructed, owing to the extremely difficult ground conditions encountered.

Construction was resumed in June, 1950, when a contract was let to Kinnear, Moodie and Co., Ltd., for the construction of the remaining 2150 yards of tunnel using compressed air as necessary. Three stationary diesel-driven compressors with a combined output of 2300 cubic feet of free air per minute were provided for the supply of compressed air at the main working area, and an electrically driven stationary compressor of 1100 cubic feet per minute capacity was provided at a smaller working area. In addition, four mobile diesel-driven compressors, each

Lined Section of Woodhead Tunnel

of 650 cubic feet per minute capacity, were provided for standby purposes at either area as required.

Precast concrete segmental linings were used to line the tunnels and shafts, the tunnel linings being mainly 6ft 5in internal diameter, and the shaft linings varying in diameter from 8ft to 13ft 6in. The main working shaft, which is 100ft from ground to invert level, was sunk in free air, and tunnelling was commenced in August, 1950. The ground in both drives was at first hard clay, but a seam of wet gravel was encountered in the downstream drive at a distance of 20 yards from the shaft, and after attempts to make further progress in free air had proved abortive, tunnelling was suspended whilst horizontal locks were constructed in both tunnels. Ground conditions in the downstream tunnel proved to be generally unfavourable, and it was found necessary to keep this tunnel under compressed air for the entire length of approximately 400 yards.

In the upstream tunnel, where a tunnel shield was employed, driving continued in hard clay for a distance of 70 yards from the shaft, when ground conditions deteriorated, and the tunnel was put under compressed air at an initial pressure of 12 lb per square inch. After driving a further 20 yards, a full face of very fine sand was encountered, and it became necessary to increase the pressure to 32 lb per square inch to keep the face dry. After the initial difficulties had been overcome, rapid progress was made with the shield in the sand. The length of tunnel driven through the sand was lined with brickwork under compressed air to form the completed sewer, whilst driving was continued in free air upstream from a new working shaft. This drive had continued for several hundred yards in hard clay when, without warning, water began to pour through the roof of the tunnel a few inches in front of the leading edge of the shield. The miners were immediately withdrawn and the tunnel was put

Usk Reservoir Under Construction

Main Wharf Extension—Takoradi Harbour

under compressed air ; when the tunnel was re-entered about twenty minutes later, it was found that some 70 cubic yards of sand had entered the tunnel during this interval. Subsequent investigations showed that the clay roof was only 1ft 6in thick at this point, and that the sand had entered the tunnel through a hole only 4in in diameter. The presence of a large cavity above the hole was subsequently revealed by thrust boring upwards from the tunnel, and, as the tunnel at this point was under a main highway, the cavity was pressure grouted through the thrust bores with complete success.

Particularly difficult conditions were encountered in one of the tunnels driven from the smaller working area, where for a considerable distance the tunnel face was in large and very open gravel. Progress in this tunnel was reduced to an average rate of 5ft in twenty-four hours, due to the necessity to keep the face and roof timbering sealed with puddled clay at all times in order to retain the compressed air within the tunnel.

Woodhead tunnel will already be familiar to many readers of THE ENGINEER, as notes of its progress have been published in these columns on several occasions. The construction of the new double-line railway tunnel for the British Railways, Eastern Region, as part of the Manchester Sheffield line electrification scheme proceeded at a somewhat greater rate during 1952, the fourth year of construction, so that despite continuing difficulties it is likely to be opened to traffic during the later part of 1953. The total length of the tunnel is just above 3 miles. During the year work was concentrated on the enlargement of the pilot tunnel, which had been completed in May, 1951, although concreting of the lining was begun in earnest. A length of the lined tunnel is shown in the accompanying illustration. Despite the varying ground, ranging from massive sandstones to poor shales, the rate of enlargement was increased from 500ft per month to 1000ft per month and maintained at about that rate for the greater part of the year, so that this work should be completed early in 1953. Lining operations started towards the end of 1951 and are proceeding at a rate of about 500ft per month, although this rate of progress may be increased as difficulties are overcome. The year's outside work, amongst other things, included the completion of a new bridge of 43ft span carrying Windledon Lane over the new alignment of the tracks, but the work of rebuilding the two stations at Dunford Bridge and Woodhead has not yet been started. The civil engineer for British Railways, Eastern Region, is Mr. J. I. Campbell, M.I.C.E., and the consulting engineers for the tunnel are Sir William Halcrow and Partners, the contractors for the civil engineering work being Balfour, Beatty and Co., Ltd.

SOME OVERSEAS WORKS

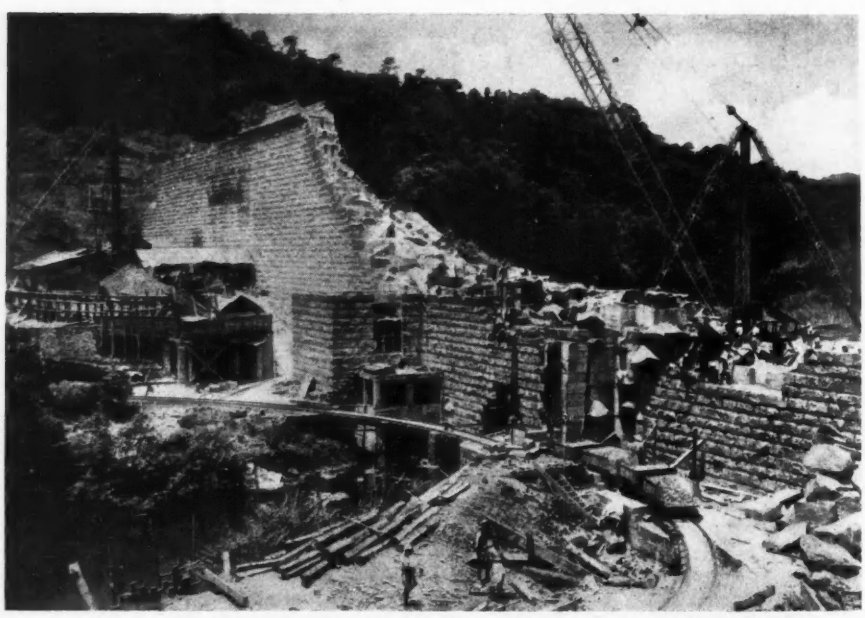
Although the economic conditions of 1952 precluded the possibility of giving many examples of large-scale works in this country, it is a tribute to the initiative of many British firms, both consultants and contractors, that these were so many examples of works being carried out by them in the Colonies and in overseas countries.

Perhaps the most ambitious example of the year was the proposal for developing an aluminium industry in the Gold Coast, based upon the hydro-electric exploitation of the Volta River, with the construction of a reservoir with a surface area of 2000 square miles and a firm power output of 564MW. The whole scheme was discussed in a Government White Paper, which was reproduced in abstract in THE ENGINEER of December 12th last.

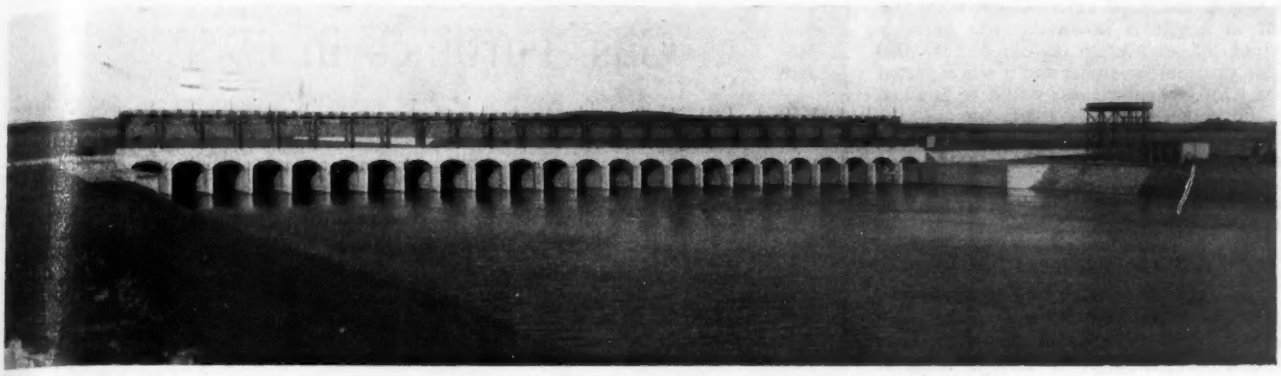
Amongst the comprehensive development suggested in the White Paper was a proposal for a new deep-water port at Tema, on the Gold Coast, and this proposal has now become an independent project, work upon which was started in 1952. A start was made with the construction of an 18-mile length of single-track railway, which, when completed, will provide a rail connection between the site of the harbour and the Gold Coast railway system. The work involves the construction of a junction with the existing Kumasi-Accra line, a temporary depot, a marshalling yard, bridges and other structures. The new line will facilitate the transport of contractors' plant, rolling stock, equipment and materials to the site.

Construction is about to begin on a further length of single-track railway between the harbour area and the quarry site in the Shai Hills, about 17 miles to the north. Most of this quarry line will eventually form part of the railway between Tema and the projected aluminium works on the Volta.

Other preliminary works under way in



Kalatuwawa Dam



Warrar Inlet Regulator from Downstream—Habbaniyah Flood Relief Scheme

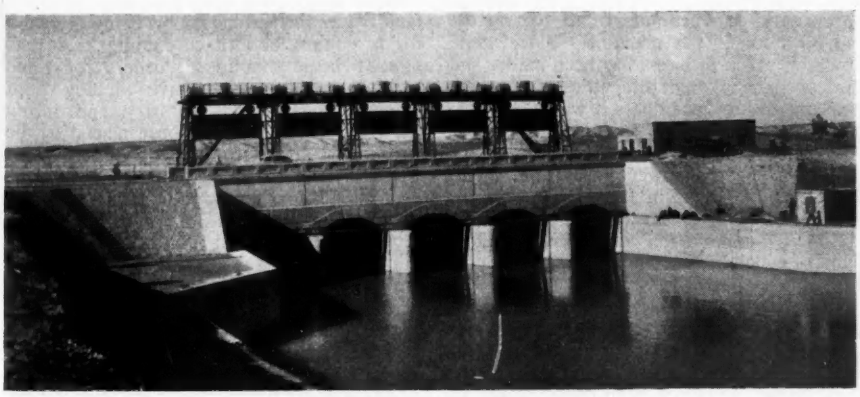
1952 included a section of the temporary camps for labour and staff, water supply and road works. Preliminary designs for the harbour and ancillary works were completed. The breakwaters, which will be rubble-mound structures, will enclose about 300 acres of water. The quays will in the first instance provide berthing accommodation for four ocean-going vessels in depths of water between 26ft and 36ft. In its final form the harbour will provide berths for twelve vessels, with room for further expansion. The harbour will be equipped with repair facilities for smaller ships (including a dry dock and slipways), transit sheds, warehouses, moorings, lighter berths, and oil berths with accompanying installations. The construction of a separate fishing harbour, outside the lee breakwater, is also included in the scheme.

The consulting engineers for the port of Tema are Sir William Halcrow and Partners and the contractors for the preliminary works Taylor-Woodrow (West Africa), Ltd., George Wimpey and Co., Ltd., and the B.B.C. Construction Company (Accra).

Not far from Tema, and also on the Gold Coast, the extensions to Takoradi harbour which were commenced in 1949 continued during 1952.* The timber depot comprising 4000 linear feet of shallow-to-medium depth quay in mass concrete, with two sheds for sawn timber, each 400ft by 175ft, with road and rail connections, was completed and partly brought into commission. The main deepwater quay extension constructed in precast concrete blockwork to provide three additional berths for handling general cargo, was nearing completion at the end of the year, as was a new double-storey transit shed, 400ft by 100ft, to provide facilities for dealing with passenger traffic. The piled foundation for a second transit shed of similar proportions was commenced. A new berth for the export of bauxite was completed during the year and brought into commission and a new tanker berth for oil imports commenced. Progress was made on the new railway layout, comprising 10 miles of sidings, 20,000 square yards of cargo platform, a cement storage shed, 300ft by 50ft in size, and roads and paved areas. The foundations for a new locomotive running shed, 225ft by 170ft, were started late in the year, and the delivery of permanent cranes commenced towards the end of the year. In all the cost of work done during 1952 amounted to £1,200,000. The accompanying illustration, taken on November 1st, shows the main wharf extension with pile driving in progress. The consulting engineers for Takoradi harbour extensions are Messrs. Rendel, Palmer and Tritton, and the contractors. Taylor Woodrow (West Africa), Ltd.

Construction of 1800ft of quay for vessels of 30ft. draught was also started at Dar-es-Salaam in East Africa. The quay wall is of solid construction and the entrance to the harbour is to be improved by dredging. The consulting engineers in this case are Messrs. Coode and Partners, and the contractors J. L. Kier and Co. (London), Ltd. The extensive port works which this same firm of consulting engineers is supervising at Colombo, were mentioned in our review last year. They comprise the construction of twelve alongside berths for the largest vessels entering the port of Colombo and an oil dock for the discharge of both heavy and light fuel oils. With good foundation material throughout the harbour all the quay walls are of the solid type. By the end of the year two berths at the north-east breakwater were completed and in use, and work on the oil dock north pier was well in hand.

* See THE ENGINEER, Feb. 15, 1952



Dhibban Outlet Regulator from Downstream—Habbaniyah Scheme

Another interesting work in Ceylon is the Kalatuwawa water supply scheme for Colombo municipality. This scheme, to provide an additional 20 m.g.d of water a day for Colombo by impounding and treating the water of the Kalatuwawa River, comprises the construction of a concrete dam, 70ft high and 1200ft long, two subsidiary earthen embankments, treatment works, &c. Construction of the dam and two embankments was in an advanced state of progress at the end of the year by direct administration under the direction of the consulting engineers, Messrs. Binnie, Deacon and Gourley. Early this year the construction of the treatment works will commence, the equipment for which the Paterson Engineering Company, Ltd., have been sending to the site. The accompanying illustration depicts the main dam in September, 1952, showing the granite faced upstream face.

In the Middle East an interesting work projected by the Government of Iraq Development Board is the construction of an arched dam, approximately 330ft high above river bed level, at Dokan, on the Lesser Zab River. The primary functions of the dam will be irrigation and flood control, with hydro electric power as a future development. The Development Board has appointed Messrs. Binnie, Deacon and Gourley to be the consulting engineers responsible for the design and supervision of the dam and associated works. Construction is to be carried out by contract, and it is anticipated that tenders will be invited early this year.

A second scheme in Iraq, which has been under construction for a number of years—the Habbaniyah flood relief and reservoir scheme—was completed early in 1952. This scheme for flood relief and storage of water for irrigation, had been under consideration for forty years. Flood water from the River Euphrates is passed through an inlet regulator, capable of discharging 2700 cumecs, into the Habbaniyah Lake, which is provided with an escape channel and regulator, designed to discharge 850 cumecs, and an outlet channel and regulator leading back to the River Euphrates of a capacity of 205 cumecs. Benefit was derived from the scheme in 1952 in the form of greatly increased crops. The accompanying illustrations show the Warrar inlet regulator and the Dhibban outlet regulator of the scheme. Our issue of June 30, 1939, at a time when work was to be started, contained a description of the scheme. The consulting engineers were Messrs. Coode and Partners and the contractors Balfour, Beatty and Co., Ltd.

Mention should also be made of the flood relief works at Samarra in Iraq, construction of which started early in 1952. The construction of a flood escape channel 38 miles

in length and flood embankment averaging 20ft in height is involved. The monthly output of excavation exceeded 1,000,000 cubic yards in November and it was expected that 1,250,000 cubic yards would be attained in December. The construction of the embankment was proceeding last year at the rate of 150,000 cubic yards per month. The total cost of the work is £6,000,000, and it is being carried out by the same two firms as are named above for the Habbaniyah scheme.

Two Water Supply Schemes

The rapid growth of Lusaka, in Northern Rhodesia, has necessitated extensive augmentation of the water supply, and new systems of sewerage, a sewage disposal works and an extensive scheme of surface water drainage, work upon which was in progress in 1952. The additional water supply is to be obtained from boreholes, whence, after softening, it will be pumped to an elevated water tower in the town. An orthodox distribution system will follow. Main laying and the construction of the water tower were in an advanced stage last year, while the two main boreholes were successfully tested. The erection and equipment of the pumping station will commence early this year.

Work was also started on laying sewers for a sewerage scheme for the town areas, and this, together with the construction of a sewage disposal works, pumping stations, &c., is expected to be completed in two years. The sewer sizes range from 6in to 18in in diameter and are of stoneware, concrete and spun iron manufacture. Treatment will be by conventional percolating filters and two-stage sludge digestion. The sewerage is on the separate system and a surface water drainage scheme for the same area will shortly go to tender. In the meantime, investigations are proceeding for the sewerage and surface drainage of the rest of Lusaka totalling approximately 25 square miles. The consulting engineers are Messrs. Binnie Deacon and Gourley.

The same consultants are also responsible for the Tai Lam Chung scheme of water supply in Hong Kong. Due to the urgent need for further water supplies in the Colony, the Government of Hong Kong decided just over a year ago to proceed with the construction of the new reservoir in Tai Lam Chung Valley. The works are to be constructed in three stages for financial reasons. The initial stage will provide storage for 1150 m.g. and a yield of 10 m.g.d., to be increased ultimately to 4350 m.g. and 40 m.g.d., this final yield being obtained partly by the construction of catchwaters. Work started on the construction of a block-faced mass concrete gravity dam, initially about 130ft high, but to be raised a further 50ft in the second stage. Water will flow by gravity from the reservoir through pressure tunnels and steel pipelines to Tsun Wan pumping station, 5 miles distant, from where it will be elevated to rapid gravity filters 340ft higher, and thence by gravity again to a 10 m.g. capacity service reservoir to Lai Chi Kok. The total cost of the scheme is about 40,000,000 H.K. dollars, and contracts were let in 1952 for the dam, pumping plant, filters, pipes and various items of equipment. Tenders will shortly be called for the tunnels and pipelaying.

"Combustion Engineering Journal."—We have received a copy of the Combustion Engineering Association's *Journal* for autumn and winter, 1952. Included is an account of the inaugural meeting of the Northern Section, some general remarks upon the Harrogate Conference, together with summaries of Mr. R. Nichols' address, "The Men in the Boiler-House," and the address, "Waste-Heat Boiler Practice in Industry," given by Mr. W. P. C. Ungold.

Gas Turbines in 1952

No. I

ALTHOUGH development work upon industrial gas turbines continued unabated during the year, makers remained unwilling to release progress details at this stage except in a few instances.

The following account gives brief details of the installations known to be under way by each manufacturer and includes where available progress up to date.

Ruston and Hornsby, Ltd., Lincoln

The Ruston 750kW prototype gas turbine continued to run regularly at Lincoln in parallel with the national electricity supply during January and the early part of February of last year, supplementing the works power supply. During the latter part of February and early March a non-stop run of 700 hours' duration was completed during which the plant ran at various loads between 800kW and 100kW under representative service conditions. With the exception of a slight tendency to carbon formation after prolonged periods of operation at very light loads, the condition of the turbine on conclusion of the winter running was very satisfactory and no signs of wear could be detected in either the main bearings or in the reduction gear.

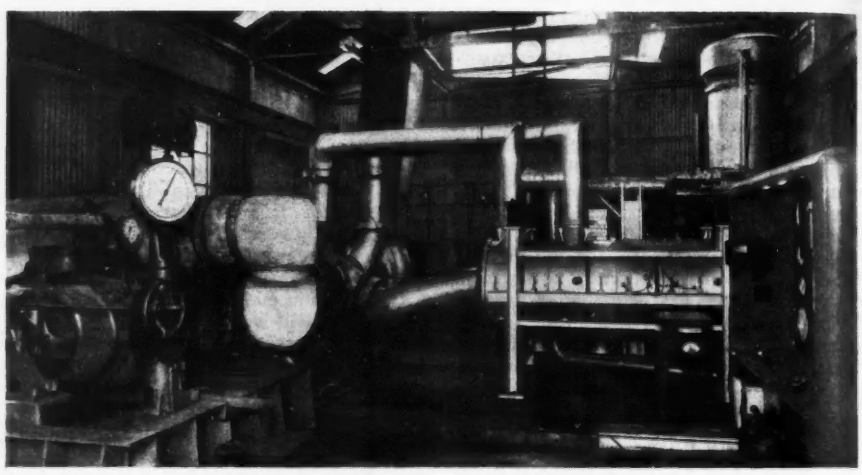
It may be recalled that the Ruston gas turbine was originally designed with two combustion chambers, as development work had not at that time advanced sufficiently to enable a single combustion chamber to be designed with confidence to handle the full air flow of the machine. Since 1946, however, much progress has been made, and in view of the inherent difficulties of matching twin combustion chambers it was decided to convert this turbine to a single combustion chamber arrangement on conclusion of the period of winter power generation. This work was completed in July and the turbine was fitted with a Ruston and Hornsby "elbow" combustion chamber, development of which has been proceeding at Lincoln for some years.

Initial running was carried out using gas oil, and promising results with a very uniform temperature distribution were given by this new combustion chamber. Since this change, work has been concentrated on the burning of heavy petroleum fuels, and much useful experience has been acquired.

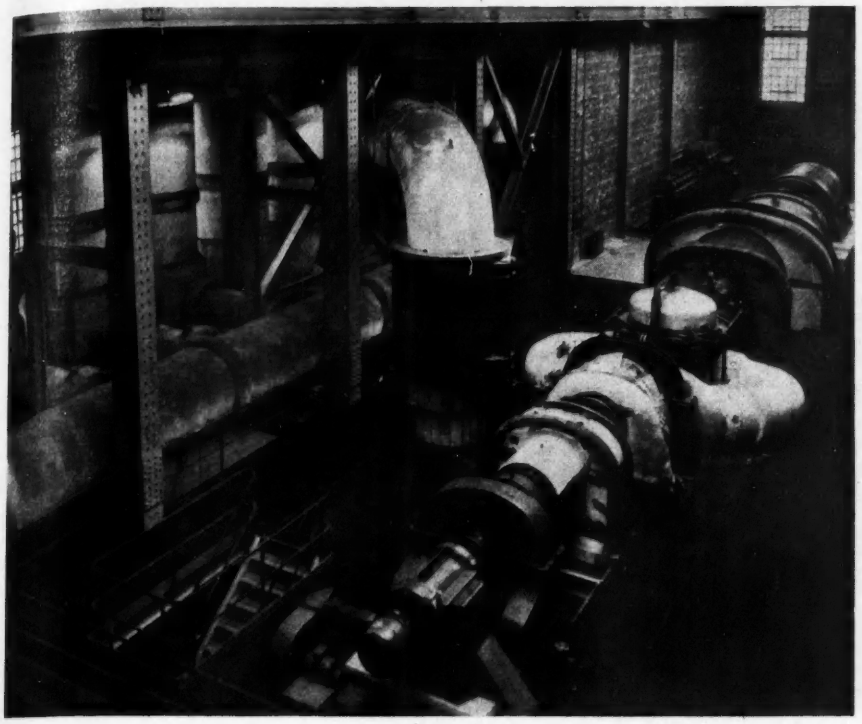
While it cannot yet be claimed that difficulties with the deposition of vanadium-bearing fuel ash have been fully overcome, definite progress has been made towards the control of such deposits by the use of additives. Simultaneously, rig tests and research work have been in progress on the burning of gaseous fuels and various liquid fuels in combustion chambers of the "elbow" design. The combustion problems, both of high calorific value gaseous fuels of the natural gas type, and of low calorific value fuels consisting primarily of carbon monoxide, have been solved, and in each case high combustion efficiencies have been achieved.

During the three and a half years' running experience on the prototype Ruston gas turbine, a large mass of operating data has been accumulated which has indicated the direction in which future developments should take place. Full advantage has been taken of this experience in simplifying the design, operating and maintenance routine of the Ruston "Mk. TA," 750kW to 1000kW gas turbine, the first unit of which had its initial test run in November. Shortly after its initial test in its non-recuperative form, this machine was run up to its full rated power and its performance was very close to the design predictions. With the exception of a slight oil leak from a bearing into the compressor, which has since been remedied, the condition of the components of the turbine after these tests was entirely satisfactory and the turbine is now being prepared for prolonged endurance running. As has already been announced, orders for three turbines of this type have already been received from the Air Ministry, and during the year new orders have been placed by the Admiralty, the Kuwait Oil Company, the Crittall Manufacturing Company. It is, however intended to provide further information of these installations as they are completed.

As we reported last month, a preliminary announcement was made in conjunction with the Ministry of Fuel and Power concerning a peat-burning turbine of Ruston manufacture. As a result of work carried out during the past year many of the special problems presented by the use of peat as an open cycle gas turbine fuel have been solved, and in particular that of controlling the feed of the powdered peat to the combustion



Combustion Chamber and Peat Feeding Arrangements



15MW Gas Turbine at Trafford Power Station

chamber. By the use of a fluidising technique, it is possible to regulate the flow of fuel with very nearly the same degree of control as with liquid fuel. Following these encouraging initial experiences, preparations are in hand for endurance testing, prior to the turbine being transported to a Scottish peat bog for site trials. Our first illustration shows the combustion chamber (on the right) and the peat feeding arrangements.

Studies have also been made regarding the possible use of other solid fuels in gas turbines, as well as the rapidly widening industrial fields for the use of gas turbines in conjunction with processes requiring large quantities of heat at high temperatures.

The company informs us that the machine shops established in one of the Lincoln works at the beginning of 1950 exclusively for the manufacture of gas turbine components are now almost completely equipped for the present batch production programme. These shops have been fully occupied during the year in the manufacture of main components and the production of parts for research and development projects.

Metropolitan-Vickers Electrical Company, Ltd.

Development continued at the Metropolitan-Vickers Electrical Company, Ltd., upon a number of gas turbine projects for widely different applications.

Its 15MW gas turbo-generating set was put on load at Trafford power station in August, 1952, thus becoming the first gas turbine plant to go into commission for the British Electricity Authority. The gas turbine is largely experimental and detail modifications will no doubt be made in the light of running experience. A detailed description of this plant appeared in The Engineer, page 343, September 12th, and the completed installation is illustrated herewith. It operates on an open compound cycle with l.p. and h.p. compressors and turbines, heat exchanger, and main and reheat combustion chambers ; it is designed for an inlet temperature of about 1200 deg. Fah. at both the h.p. and l.p. turbines and an overall pressure ratio of 10 : 1. It is burning gas oil at the outset, but the design is such that preheated residual fuels can be used at some future date.

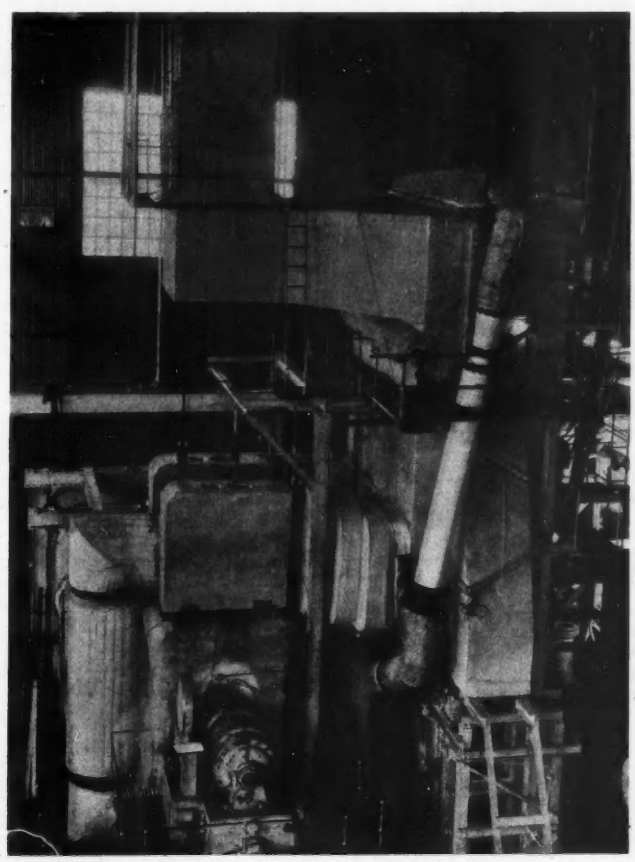
A 1750kW set incorporating a gas turbine designed to burn natural gas has been completed for Shell Petroleum and has undergone tests in Holland on this fuel before being shipped to Venezuela. A 2500kW set for the Metropolitan Water Board has also been completed and tested, burning gas oil.

It will be recalled that both these units work on a simple open cycle design based on this company's locomotive gas turbine. A particularly interesting plant on which this company is working is the 2000kW set, burning producer gas, which is for the Ministry of Supply. This plant works on an open cycle and has a fifteen-stage axial compressor driven by a four-stage fixed shaft turbine. The plant incorporates a pressurised gas producer working at six atmospheres which is pressurised by a supercharging turbo-compressor. This latter unit runs at 27,500 r.p.m. and employs a radial flow turbine working at 650 deg. Cent. The actual gas producer is being made jointly by the Incandescent Heat Company, Ltd., Burnley, and Joseph Lucas, Ltd., also of Burnley. As yet no further information has been published.

The company has been actively engaged on relatively small single shaft gas turbines of aeronautical configuration for a number of years. The basic design of this range goes back to 1938, when the Company began developing an axial flow gas turbine employing an annular combustion chamber. The "Beryl" engine which was fitted to the Saunders-Roe "SRAI" flying-boat shortly after the war was closely associated with that development. The "Beryl" itself later formed the basic design from which the "Sapphire" jet turbine was developed. Similarly, the "Gatric" gas turbine fitted in the M.G.B. "2009" in 1947, the first vessel to be so propelled, has the same general pattern. It has an annular combustion system, a nine-stage axial compressor driven by a two-stage, fixed turbine, and a four-stage free turbine drives the centre propeller.

Following the successful operation of these 2500 s.h.p. units, four larger gas turbines, each of 4500 s.h.p., were ordered by the Admiralty for similar duty. The new turbines which are described elsewhere in this issue are of an improved design in which the power-weight ratio of the complete unit including gears is 2·16 lb/s.h.p. as compared with a ratio of 2·78 lb/s.h.p. for the earlier engines. They have now been installed in two new motor torpedo-boats, "Bold Pioneer" and "Bold Pathfinder"; each vessel has two gas turbines for use as boost or maximum speed engines, the cruising and manœuvring power being provided by diesels. Sea trials on the first of these ships were reported in The Engineer, November 28th.

The Metropolitan-Vickers 3000 h.p. locomotive gas turbine has undergone an extensive series of tests during the final months of last year, and in April entered regular passenger service between London and Bristol, being



The Pametrada 3500 s.h.p. Marine Installation

transferred later to the London–Plymouth route. On this route it had a 600-mile a day schedule and had completed some 55,000 miles by the middle of December. It has been subjected to special heavy load duties and on one occasion was able comfortably to restart on the Hemerdon gradient (1 : 42) and to proceed at 17 m.p.h. when hauling eighteen coaches.

This locomotive was fully described in THE ENGINEER, Feb. 1st and 15th, 1952, and some footplate experiences were described by Mr. E. H. Livesay in the Oct. 3rd, and 10th, 1952 issues. The gas turbine works on a simple open cycle arranged in line without a heat exchanger. The compressor has fifteen axial stages and develops a pressure ratio of 5·25 at 7000 r.p.m., the mass flow being 50 lb per second. It drives a five-stage turbine having an austenitic rotor with "Nimonic" blading for the first and second stages. The unlined flame tubes have an inner primary chamber, both components being of austenitic steel, and six of them are arranged around the longitudinal axis of the engine. On full load the turbine has demonstrated on test a thermal efficiency of 19 per cent and the overall efficiency at the wheels is stated by the company to be 15½ per cent, the fuel consumption under this load being 0·88 lb/h.p./hr.

THE ENGLISH ELECTRIC COMPANY, LTD.

A number of industrial gas turbines were undergoing development tests at the Rugby works of the English Electric Company, Ltd. Amongst them was a 2000kW set for the Ministry of Fuel and Power, designed to burn coal in conjunction with a cyclone slagging chamber. This combustion chamber is now undergoing separate tests. Apart from the combustion plant, this company is known to have an order for a similar set to burn firedamp and auxiliary coal. No other information is yet available on the larger units here being developed, including units of up to 20,000kW which are the largest in this country.

Shore tests have, however, been completed on a 6000 s.h.p. set intended for marine propulsion. This unit is claimed to have the largest known power output for marine gas turbines.

THE BRITISH THOMSON-HOUSTON COMPANY, LTD.

The information afforded us by the British Thomson-Houston Company, Ltd., has been restricted to that concerning its marine commitments and we learn that it has concentrated on the fulfilling of orders placed with the company in 1951 rather than on the development of new projects. Nevertheless, the value of the orders received in 1952 has been considerable. The larger among them covered turbo-alternator sets for new ships planned for the tanker fleets of the British Tanker Company and the Anglo-Saxon Petroleum Company, two of the companies for which a very large quantity of work is already in hand.

Among the main propulsion equipment completed or in hand, chief interest is probably centred around its gas turbine contracts, and, in this connection the latest information of the "Auris"—the Anglo-Saxon Petroleum Company's tanker for which B.T.H. built the first marine gas turbine to go into commercial service—is that the unit has shown itself to be reliable in service and is operating satisfactorily.

Early in the year the gas turbine installation alone powered the ship during a complete Atlantic crossing from Plymouth to Curacao, a distance of 3897 miles covered at an average speed of 7·35 knots. Up to the middle of September, when the "Auris" returned to the Tyne for her annual refit, the gas turbine had run fully loaded for 5100 hours during the eleven months since it had been fitted, and the ship had sailed 52,898 miles.

Several references in the past have been made in THE ENGINEER to this open cycle gas turbine set, and we refer to the general description appearing in the issue February 23, 1951, for the following brief details. On a main base is a six-stage, low-pressure turbine direct coupled to the alternator. Arranged vertically above this turbine is the seven-stage, high-pressure cylinder mounted on a common shaft with the twenty-four-stage compressor, this arrangement having been dictated by space considerations. The contra-flow heat exchanger is placed vertically admitting compressed air from the top. The set employs two combustion chambers and the maximum cycle temperature is (h.p. inlet) 1113 deg. Fah. On early tests 930kW were developed at the alternator terminals, the fuel consumption being 0·884 lb per kilowatt-hour, and the efficiency 21·1 per cent.

Following the success of the gas turbine equipment fitted in the "Auris," the maker and the Anglo-Saxon Petroleum Company are at present making preliminary investigations in connection with a projected new tanker which will be powered solely by gas turbines. Two gas turbines will be fitted, each capable of developing 4150 h.p., and they will be arranged to drive a single propeller shaft, probably by means of electric transmission.

PAMETRADA

Gas turbine development as revealed in the annual report of the Parsons and Marine Engineering Turbine Research and Development Association has ranged over an extensive field of component research and investigation as well as being concerned with its 3500 s.h.p. marine gas turbine, which we illustrate on page 87. We include here some items abstracted from the report.

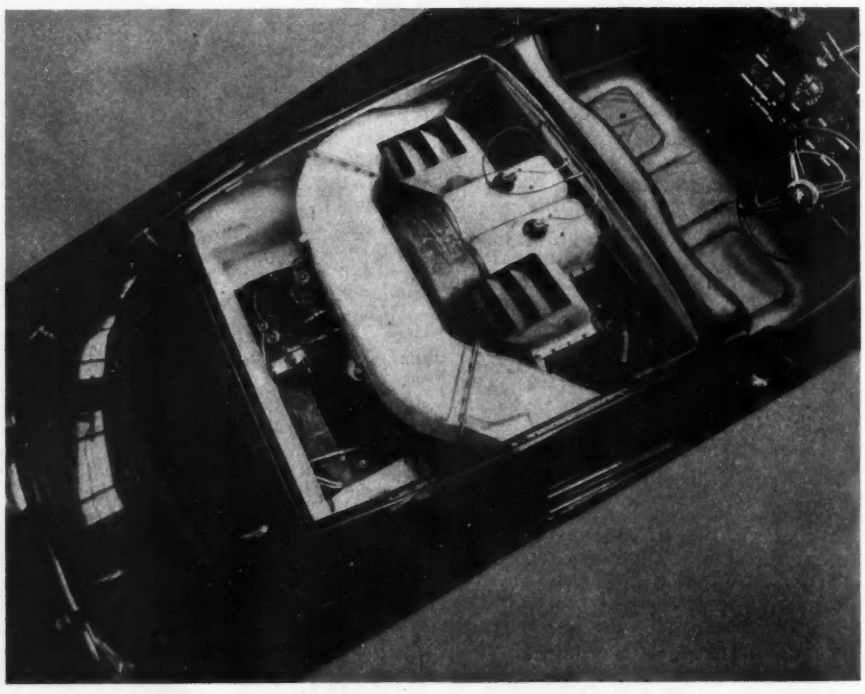
During the year the 3500 s.h.p. marine gas turbine has run for a total of 242 hours with the l.p. turbine giving power for 190 hours, and the set developing 3650 s.h.p. for twenty-five hours. Component failures prevented the completion of a 100-hour full power trial. Shortening of the rotor blades and other related modifications to reduce the annular flow area of the l.p. compressor by 20 per cent, reduced the mass flow and set back the surge line a distance of 25 per cent of the original mass flow at each point. It now almost occupies its design position. Other work completed was the fitting of cascades in the l.p. compressor outlet and the h.p. compressor inlet ducts and the removal of internal stays to reduce pressure loss. Pre-inlet guides were fitted to the h.p. compressor and drains were fitted to the intercooler tubeplate to prevent water passing into the h.p. compressor. Washing with a 1 per cent solution of "Lissapol," followed by warm water, effectively loosened the dirt on the blades.

Air leaks in the heat exchanger had to be remedied and corrosion in the aluminium bronze tubes in the first pass was discovered, due to sulphuric acid condensation, possibly occurring at starting. Radiation shields were fitted between the flame tubes and the air casings of the combustion chambers to reduce temperatures which were too high for aluminised mild steel. Various repairs and improvements have been effected in the h.p. and l.p. turbines as a result of experience on the test runs, including corner cascades in the l.p. exhaust ducts to improve gas distribution, and the use of a "Tufnol" plate to eliminate stray currents from the dynamatic brake.

Later it was possible to carry out a continuous 100-hours full power test, and the following mean performance figures were achieved :—

S.h.p. (corrected to 14·7 lb per square inch and 60 deg. Fah.)	3532
H.p. turbine inlet temperature (corrected to 60 deg. Fah.)	1242 deg. Fah.
L.p. turbine inlet temperature (corrected to 60 deg. Fah.)	1284 deg. Fah.
H.p. turbine speed (corrected to 60 deg Fah.)	4650 r.p.m.
Thermal efficiency	27·9 per cent
Fuel consumption (corrected to 60 deg. Fah.)	0·505 lb/b.h.p./hr

After the test an inspection was made by



The Rover "Jet I" Road Gas Turbine

Lloyd's and a satisfactory report returned. During the period of opening up, the opportunity was taken to carry out certain modifications: new glands were fitted to the h.p. turbine, a water eliminator to the discharge side of the intercooler, an additional row of blades fitted to the l.p. compressor and changes were effected to the mixer following the two reheat combustion chambers.

The designed consumption was 0·54 lb/s.h.p./hr. and the best figure obtained to date is 0·49 lb/s.h.p./hr. The turbine has been running on distillate fuel, but, following the proving of the unit after reassembly, residual fuels will be used.

Amongst the year's general work are investigations concerning the erosion occurring in oil fuel sprayer vortex chambers, combustion chambers, and refractory linings. An estimate of the size of regenerative heat exchanger has been made and a study made of the possible use of sodium-potassium eutectic alloy as the heat carrier. The effect of various additives in a descaling bulk upon the corrosive action of vanadium containing fuel ashes has been studied and experiments have been carried out to determine the dynamic characteristics of porous metal gas turbine blades.

In the first half of the period under review in the report, a theoretical investigation has been made of the heat transfer process associated with the cooling system proposed for the turbine rotor, in which the liquid enclosed within the blades is used as a conveyor of heat to the roots which are cooled by the main circulating water. Little experimental data have been published which were obtained under conditions strictly comparable to those which will apply in practice, but extrapolation of results from more conventional experimental investigations indicates that a mean blade temperature should be attainable which is compatible with long life operation of a turbine. In view of the uncertainties connected with the heat transfer process, however, this conclusion should be accepted with considerable reserve until it can be confirmed or otherwise by experiments to be made on the liquid blade-cooling rig. The detailing of this rig is practically complete, and the forgings for the major stressed parts (shaft and rotating arms) have been received.

During the latter half of the period with which the report is concerned a start was made upon the design of a single-stage turbine with which it is hoped to gain experience of operation at high gas temperatures and also to develop the mechanical layout of the main cooling system. Considerable progress has been made in the design of the rotor, and it is hoped that the basis plan for the whole machine will be completed in the next quarter. Provision is being made for nozzles of uncooled ceramic, sweat-cooled porous sintered alloy, or of solid metal cooled by liquid metallic alloy, according to which form shows most promise in preliminary tests.

In the development of refractory turbine blades Morgan Crucible, Ltd., has made good progress, both in manufacturing methods and the evolution of new materials. It is now anxious to test actual blades under realistic conditions, and a rig for the purpose has been built and should be in operation shortly at Pametrada.

Another scheme includes experiments to determine the aerodynamic characteristics of porous metal sheet turbine blades. A cascade, containing hollow porous blades through which cooling air could be passed, was made and mounted on the l.p. air test rig. Traverses, at the exit plane of the blades, were made for various inlet angles and coolant flows, to determine the total head pressure losses.

During the preliminary tests it was found that the main air stream was not following the contour of the blades, but was flowing in through the leading edge of the blades and out through the trailing edge, resulting in very high pressure losses and loss of deflection. In an attempt to prevent this flow through the blade section, baffles were made and placed inside the blades. It was found that with a camber line baffle and one transverse baffle the flow round the blades was very much improved, the loss approximating to that for non-porous blades of the same section.

The cascade was tested for coolant flows up to 3 per cent of the main stream flow and it was found that as the coolant flow was increased so the total head pressure loss through the cascade increased.

Tests have also been carried out on the uniformity of various samples of porous sintered metal sheets, with a view to fabricating blades from them. A sweat-cooled porous cylinder has been run for fifty hours in the efflux from a combustion chamber alongside an uncooled solid stainless steel cylinder. The cooled cylinder remained at less than half the gas temperature, and showed no signs of having its porosity reduced by the vanadium ash from the "doped" fuel being burnt in the chamber.

The Rover Company, Ltd.

During last year a number of officially observed test runs with "Jet 1," the Rover gas turbine car, illustrated opposite, culminated in the establishment of a mean speed over a measured mile of 151·196 m.p.h. (243·327km.p.h.) on the Jabekke highway in Belgium. Subsequently, after stripping for inspection by the R.A.C., and reassembling with all the original components, the car has been passed into almost everyday use to gain further knowledge of control and maintenance requirements of gas turbine vehicles.

Development work on small gas turbine units for commercial and military applications has actively proceeded and component testing designed ultimately to increase thermal efficiency, reduce weight, and increase operational time between inspections, has been carried out. Considerable attention has been given also to advanced metallurgical, combustion and manufacturing techniques.

(*To be continued*)

The Royal Navy, 1952

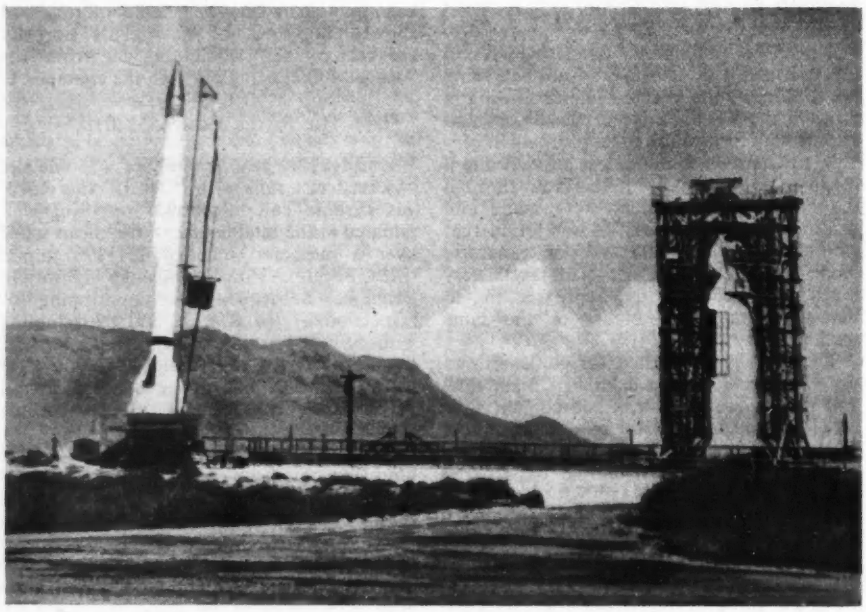
(*By our Naval Correspondent*)

No. III—(*Concluded from page 47, January 9th*)

Research and Development

WHEN presenting the current financial year's Navy Estimates, the First Lord gave some indication of the results of the Navy's research and development since the war. In particular it was encouraging to hear that this country had made good progress in the development of the guided missile for defence purposes. He described the guided rocket as the most promising weapon in the anti-aircraft armoury for use at ranges between those at which our fighter aircraft and anti-aircraft guns can operate. Anti-aircraft guided rockets are in an advanced stage of development in the United States and General Collins, Chief of Staff of the U.S. Army, has expressed the view that they should be able to bring down an aircraft flying at 60,000ft. These surface-to-air missiles are indeed likely to prove indispensable for the destruction of high altitude bombers. The high speed of modern interceptor fighters makes manœuvring a matter of some strain but a guided missile can be turned sharply at over 500 miles an hour. The United States has also developed and tested successfully long-range surface-to-surface missiles of two kinds—a rocket similar in appearance to a "V2" and a winged missile akin to the "V1" flying bomb. On August 7, 1951, a 5½-ton, 48ft-long "Viking" rocket, built by The Glen C. Martin Company, reached an altitude of 135 miles and a speed of 4100 miles an hour (page 90). The self-propelled missile has been used in Korea and has been launched successfully from submarines. Existing designs of this kind are fitted with a television installation by which the launching ship or controlling aircraft is able to guide it to its target. The effect of guided missiles on naval operations and on the design of ships may well be profound. On the one hand, ship-launched surface-to-surface rockets—fitted in all likelihood with atomic warheads—will give warships, both surface and submarine, immensely increased offensive power. On the other hand, the air-to-surface guided missile against surface vessels makes their anti-aircraft defence a problem of increasing difficulty when operating in enemy waters.

Other post-war developments are minesweepers of entirely new design with more efficient sweeping gear to deal with magnetic, acoustic and other kinds of mines, and improved anti-aircraft guns with greater range, accuracy and destructive power, both for warships and merchant vessels. Research in the various fields of naval construction has made it possible to design ships' structures to closer margins of strength, with a consequent saving of hull weight, which has been used to increase the fighting efficiency of H.M. ships. Good progress has also been made in the development of high performance steam, light-weight diesels and gas turbines for warship propulsion and in parallel design for auxiliary machinery with the aim of obtaining the greatest efficiency in performance for a minimum of weight and space, and a maximum economy in fuel consumption. Three designs of diesel engines have been developed and are now being produced in quantity, the policy of standardisation of three types avoiding the very great maintenance problem involved in World War II when over 400 different types of internal combustion engine were in use in Admiralty service. For a power rating up to 2500 b.h.p., the "Deltic" has been developed—a light-weight, high-powered, opposed-piston, two-stroke cycle engine, details of which have already been given in this journal. This class of engine will be invaluable for light displacement craft requiring high speed and will eliminate the high fire risk and other disadvantages of the petrol engine hitherto used in this kind of vessel. The Admiralty Standard Range I diesel covers a power range of 750–2000 b.h.p. and will be installed in a number



U.S. Navy's 5½-Ton, 48ft Martin Viking Rocket

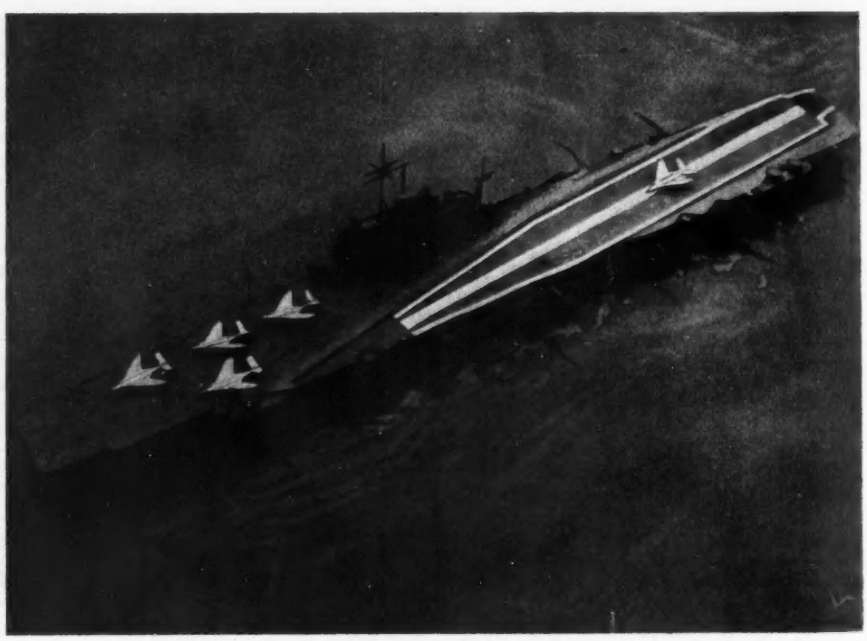
of frigates now under construction. This type of engine is exceptionally compact and produces more power for a given weight than any previous designs. The Standard Range II diesel covers requirements between 200 and 800 b.h.p. for the propulsion of small warships, such as our new inshore minesweepers, and for auxiliary machinery. This engine is a new light-weight vee unit, designed and produced by Davey, Paxman and Co., Ltd. It is now in quantity production at the designers' works and licences have been granted for production by Ruston and Hornsby, Ltd., and Ransome, Sims and Jefferies, Ltd. Many of the major components are constructed of aluminium alloy, thus achieving considerable saving in weight without sacrificing the necessary sea-keeping capabilities.

A new British development of great importance is the steam-powered catapult, which is now in quantity production and is being installed in British, Dominion and United States carriers. The new catapult has been developed for the Royal Navy by Brown Brothers and Co., Ltd., Edinburgh, and uses the principle of the slotted cylinder. It has no rams or purchase cables. A hook on the aircraft to be launched is connected directly to a piston, which is driven along the cylinder by high-pressure steam. The catapult takes up less working space than do the most powerful launchers of conventional design and calls for no alteration of the level of the flight deck. Apart from the tactical advantage it gives to carriers by enabling them to launch their aircraft off-wind, its importance lies in the fact that the conventional hydro-pneumatic wire purchase equipment had reached its limit of size and left no margin for still heavier aircraft in the future. A further increase in the operating efficiency of carriers has resulted from the new flight deck arrangement for landing on aircraft at an angle of 8 deg. to the fore and aft line as illustrated herewith. Aircraft which have failed to engage the arrester wires when landing-on can open up to full power and take-off again for another attempt without running into the barriers placed across the deck to safeguard the parking area amidships. Moreover, with this "angled layout," the arresting area can overlap the parking area, which, in effect, increases the length of the flight deck by 40 per cent and thus enables more aircraft to be landed on in a given time.

Good progress has also been made in the development of underwater television equipment (page 91). Two cameras for work at depths of 1000ft are now under trial, with built-in facilities for changing lenses, focus and aperture under water by remote control. Salvage and ships' hull inspection, sea-bed survey and marine biological and oceanographical research are some of the obvious applications of underwater television. Improvements in the facilities for escaping from a sunken submarine have been made during the past year: all new submarines are to be equipped with one-man escape chambers in lieu of the existing method of escape through the hatch after the compartment has been flooded, and a 100ft escape tower has now been erected at submarine headquarters for training in escape. New kinds of breathing apparatus and life jacket have been developed, and a rescue bell obtained from the United States has given promising results. Indicator buoys fitted with a light have now been adopted and a new type of buoy with an automatic wireless beacon is under trial. It has been decided not to fit submarines with automatically-released indicator buoys, as these buoys would have to be removed on the outbreak of war. Moreover, as long as one man remains alive in a submarine, it should always be possible for him to indicate her position.

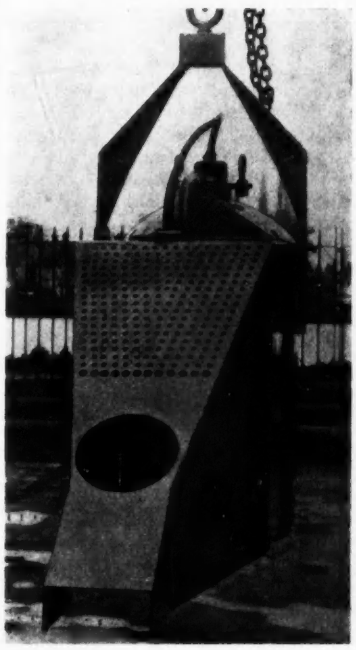
The United States Navy has also announced other interesting developments. A new sound fixing and ranging instrument picks up under-water sounds up to 300 miles distant, and should prove useful in search and rescue operations for finding rafts or crashed aircraft equipped with small bombs for exploding under water. Midget minesweepers have been built for lowering from ships of a Task Force to clear a suspected minefield and an improved mine detector is now available—for both land and under-water use—which detects mines both visually and also orally in a headset worn by the operator. The U.S. Navy has also developed a new motor-operated fire extinguisher, which can deliver 2000 gallons of foam a minute at 60 lb pressure, either in a long distance straight stream or in the form of a protective cone-shaped curtain.

Personnel.—Including officers and men retained beyond their normal period of service and those called up from reserve, Vote "A" provides a personnel strength of 153,000 during the current financial year, a figure which allows also for nearly 5500 in the Women's Royal Naval Service. Commencing in April, 1953, the period of retention of men who have completed their normal service will be progressively reduced from eighteen months until, by April, 1954, none will be retained after completion of their engagement. There has been a very encouraging improvement in the number of men re-engaging for pension as a result of the pay and pension increases, re-engagement bounty and the opportunities now afforded for a life career in the Navy for Chief and Petty Officers up to thirty-two years service.



Model of Aircraft Carrier with Angled Flight Deck

Recruiting remains satisfactory, though special service (seven years active, five years reserve) is still more popular than the full twelve years first period of long service and it has been decided to extend the entry of youths between 16¼ and 17¼ to the seamen and communication branches. Entries of National Service men are being increased for this year to about 3000, thus raising the number now serving from 4500 to 6000. The strength of the Royal Fleet Reserve—the force of trained men who will be required immediately on mobilisation to form the crews of Reserve Fleet ships—has inevitably been effected by the retention of time-expired men and has fallen temporarily from the normal 25,000 to 20,000. Recruiting of ratings from the Merchant Navy for the Patrol Service Section of the Royal Naval Reserve is satisfactory, but has been disappointing for the General Service Section. Officers are entering in the required numbers, but the overall strength of the Reserve does not yet exceed 4480 officers and men. To improve recruiting, a scheme is now in force which enables boys who have done training in the Sea Cadet Corps or in a sea training school to enrol in the Royal Naval Reserve at the same time as they join the shipping industry. They may join the R.N.R. as junior seamen at the minimum age of 16¼, and are advanced to Ordinary Seaman when 17½.



Flood-Lighting Structure of New Underwater Television

The Royal Naval and Marine Volunteer Reserve Forces are increasing their numbers steadily and are expected to reach a strength of 11,000 and 1500 respectively this year. About 9500 National Service men, who do not belong to the Volunteer Reserve, are doing their part-time training in the newly formed Naval Special Reserve. National Service men granted officer rank in the R.N. Volunteer Reserve may now volunteer for service in submarines and if successful in their training and examination will be appointed as Fourth Officer of a submarine—with 4s. a day extra pay—during the final months of their compulsory service. National Service officers from the R.N.V.R. Engineering and Electrical Branches may also apply for permanent commissions in the Royal Navy under the conditions of the "University Candidate" scheme of entry. Short Service Commissions of three, four or five years in the Instructor Branch—with the possibility of selection for permanent service—are being offered to University Graduates and teachers with qualifications in engineering, science and mathematics. The new sixteen-year age, Dartmouth entry, introduced in 1948, is not providing sufficient officers of the right standard, particularly from Secondary Grammar Schools, from whom it was hoped to obtain 50 per cent of the entries. A committee has now been set up to review the present methods of entry and to report whether alternative methods of entry should be introduced bearing in mind, that a fair chance should be given to every boy who has the qualities and qualifications required to make a good naval officer.

Operations and Exercises.—Ships of the Royal Navy and the Dominion Navies continued to operate off the west and east coasts of Korea throughout the past year. A force which includes two British cruisers and a British carrier effectively controls sea communications in the area and prevents attacks on the numerous islands off the west coast now held and used by the United Nations. Enemy troops and other military targets are constantly engaged by our naval units. The aircraft carrier provides constant reconnaissance and carries out daily air strikes against hostile targets on the mainland, giving close support to the United Nations armies as and when required.

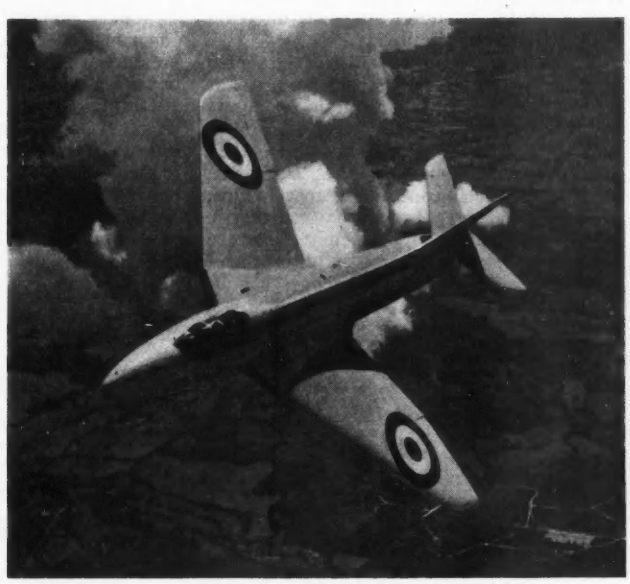
The past year has been notable for the progress made by the N.A.T.O. navies in establishing a common doctrine and in working together as a team. This has been clearly brought out in the four large exercises carried out since January, culminating in the thirteen-day exercise "Mainbrace" in September, in which 160 ships, as well as hundreds of aircraft, and the military forces, of eight N.A.T.O. nations took part. The exercise was designed to test the command organisations of the Eastern Atlantic at all levels. According to the Supreme Commander Atlantic, Admiral McCormack, the results showed the need for many more carriers, anti-submarine aircraft, and minesweepers. To facilitate communications between the various N.A.T.O. navies, small formations of any kind of ship are now known as squadrons, while two or more squadrons of destroyers or other smaller types of ships grouped together form a flotilla.

The usual courtesy visits have peen paid by H.M. ships to foreign ports, including Ferrol and Barcelona, and towards the end of the year, the "Vanguard," "Eagle," the cruiser "Swiftsure," destroyers, frigates and submarines exercised in the Greenland sea to give personnel experience of operations and to test equipment under severe weather conditions.

Aeronautics in 1952

No. III—(*Concluded from page 57, January 9th*)

As the delta aircraft remained under speed restrictions at the time of S.B.A.C. flying display in September, the high-speed runs were all carried out by swept-wing aircraft. The principal fighter aircraft in this category are the Hawker "Hunter" and the Vickers "Swift" in the super-priority production group, and the de Havilland "110." It was announced before the display that the "110" and the "Hunter" were including transonic dives slightly in excess of Mach No. 1, in routine development flying, and consequently during the display the pilots responsible for the flight testing of these aircraft were "cleared" to include demonstrations of the sound phenomena associated with flight at sonic speeds. The pattern of these demonstrations followed previous years' practice, but the initial dive was carried out from a greater height. In the course of the dive the pilots were usually able to attain speeds slightly in excess of Mach No. 1. Their speeds during the fly past were something less than this and have been estimated at between 680 and 720 m.p.h. The dives were usually associated with two loud bangs less than a second apart, which preceded the arrival of the machine.



The Hawker "Hunter"

The exact cause of this aural phenomena has been open to much conjecture and we refer to an article* in the *Hawker Siddeley December Review* for the following explanation which is advanced by the project office of the Hawker company. In an introduction to the explanation Mr. V. Stanbury, in charge of that office, maintains that the phenomenon is not associated with the generation of shock waves by the aircraft, and he is of the opinion that the bang is simply a "build up" of noise mainly generated by the engines. Furthermore, the bang is

* Mr. J. W. Fozard, D.C.Ae., B.Sc., Grad.R.Ae.S., Hawker Aircraft Company, Ltd.

The First Prototype Vickers " Valiant "

generated only when the aircraft is accelerating through or decelerating from sonic speed, which would account for the double report generally heard. The following theory and diagrams are abstracted from the article.

" Let us first consider a point source of noise moving through air at a speed of half that of sound, i.e. at a Mach number of 0·5 (see diagram *a*). If this noise source is considered to be at point *A* at any given time and points *B*, *C*, *D*, *E*, &c., are the positions it occupied at say, 1, 2, 3, 4, &c., seconds previous to the instant being considered ; then the instantaneous noise emitted by the source when it occupied the positions *B*, *C*, *D*, *E*, &c., has radiated in all directions from each of these positions so that it lies at a distance of $t\,x$ from its origin, t being the time taken by the source to move from this origin to position *A*. It will be seen from the figure that the actual noise precedes its source along the direction in which the source is moving.

" Now let us consider the case of the source of noise moving at supersonic speed, say at a Mach number of 2. Diagram (*c*) shows the position, at the instant when the source is at position *A*, of the noises emitted when the source was at positions *B*, *C*, *D*, *E*, &c., these positions being one second apart in time, as in diagram (*a*). It will be seen that in this case the actual noises emitted by the source lag behind it along the direction of its motion and that enclosing lines can be drawn which are tangential to all the circles. The circles and lines are, of course, merely sections of spheres and a cone, respectively, the Mach cone. All the noises emitted by a body moving at supersonic speed must lie inside this cone, the angle of the cone being a function of the Mach number.

" It is obvious, then, that at some condition between the two examples quoted above the circles will all intersect at one point. Such a condition occurs when the semi-angle of the Mach cone is 90 deg., i.e. at a Mach number of 1·0. At this speed the noises emitted by a body will travel with it in its direction of motion, as is demonstrated in diagram (*b*).

" Thus the noises emitted by an aircraft in flight at a speed equal to that of sound will remain with the aircraft in the direction of its flight path for as long as it maintains sonic speed, and will continuously reinforce and build up into a pressure field around the aircraft which, as far as the human ear is concerned, assumes the audible characteristics of an explosion. The explosive effect of the pressure wave is only apparent to a stationary observer. As far as the pilot is concerned he is likely to be unaware of its presence whilst actually generating it. Even in the case of a bang which overtakes his aircraft, his speed relative to the wave will be small and thus the rise of pressure with respect to time will be relatively low. This is the mechanism of generation of the sonic bang. It follows immediately that the intensity of any given bang is a direct function of the time that the aircraft has spent travelling at sonic speed. If it were possible to fly for a prolonged period at a speed equal to that of sound, the bang thus generated would probably assume alarming intensity and might have physical effects somewhat akin to those of bomb blast. The argument has been advanced that because of this pressure field which builds up around the aircraft at $M=1{\cdot}0$, it will be physically impossible to maintain steady flight at this speed. This amounts to the postulation that at a Mach number of unity the forces on the aircraft are functions of time. This, however, remains to be proved and will probably remain in doubt until such time as sonic speed is attainable in level flight."

It was following one of these demonstrations, on September 6th last year, that John Derry and his observer were killed when the " D.H.110 " disintegrated within the precincts of the aerodrome at low altitude. An engine and debris from this machine fell on the public enclosures and twenty-seven people died from injuries sustained.

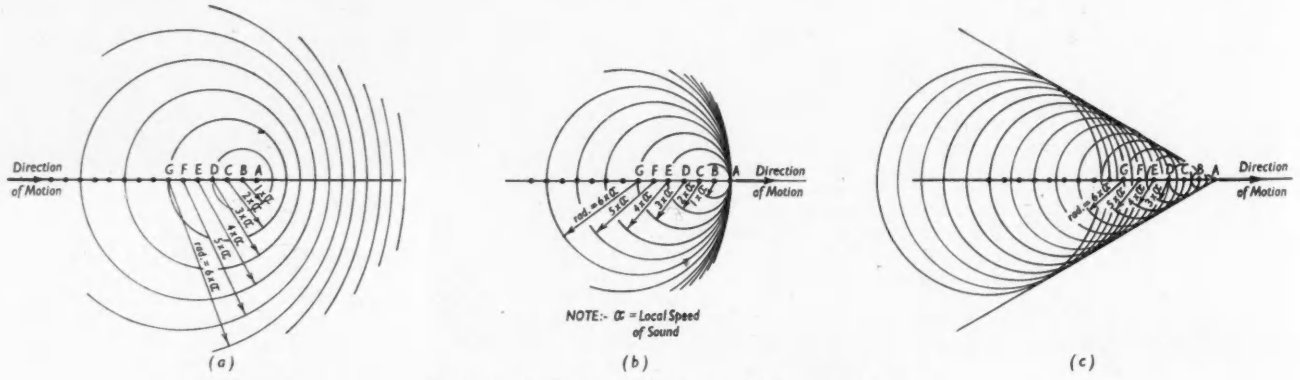
There are now six aircraft in this country on super-priority production. Of these the Hawker " Hunter " and the Vickers " Swift " with single power units, the English Electric " Canberra " twin-engined bomber, and the four-engined Vickers " Valiant " bomber, all have Rolls-Royce " Avon " axial-flow turbo-jet engines ; the delta-wing Gloster " Javelin " multi-purpose fighter has twin " Sapphire " axial-flow turbo-jets made by Armstrong Siddeley, Ltd., and the Fairey " Gannet " which is the only aircraft with super-priority for the Royal Navy, and with a propeller-turbine engine—the Armstrong Siddeley " Double Mamba." It was recently announced that the Royal Australian Navy has also ordered this aircraft. Another fact recently disclosed is that a second version of the " Hunter " is to have a " Sapphire " engine, which has a higher rating (8300 lb static thrust) than the " Avon " engine—still officially rated at 6500 lb.

This country still clearly maintains her lead in gas turbine design, particularly in respect of the " Avon," " Sapphire " and " Olympus," which are generally regarded as being the finest production engines in their class in the world.

The " Olympus " made by the Bristol Aeroplane Company, Ltd., is an axial-flow engine employing for the first time two compressors in series, their shafts running concentrically and each being driven by its own turbine stages. It is an engine employing a very high compression ratio and is in the 10,000 lb static thrust class.

During the year work was done by Rolls-Royce on the " Conway " by-pass engine.

Another entirely new engine to be announced last year is the Napier " Eland," a single-shaft gas turbine, designed for use with a constant speed propeller. The engine, which develops 3000 e.s.h.p., is notable for its specific weight, 0·525 lb per e.s.h.p. Its maximum diameter is only 36in. Its fuel consumption is about the same as the Bristol " Proteus III " prop-turbine of 0·49 lb per horsepower hour.

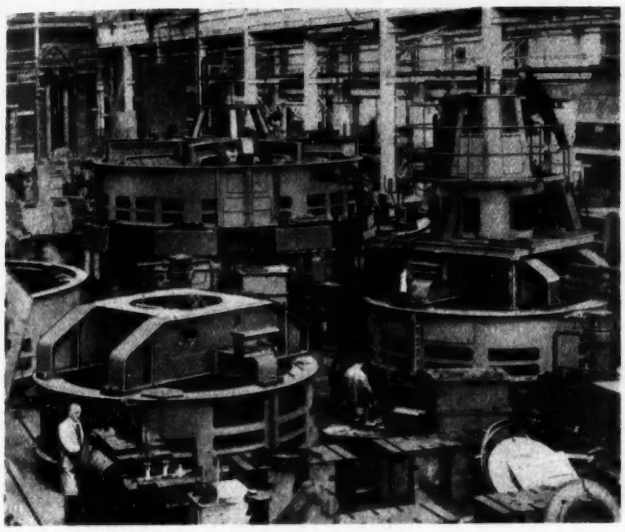


Diagrams of Sound Propagation from a Moving Point Source

Electrical Engineering in 1952

No. II—(*Concluded from page 65, January 9th*)

FAIR evidence of the state of activity of the heavy electrical manufacturing industry in 1952 was contained in the recent announcement that a total of 1550MW of generating plant was commissioned by the B.E.A. in the year ended December 31st last. This record installation figure, together with all the associated auxiliary plant and equipment, represents a substantial achievement. It is, however, only part of the story, since it should be remembered that the electrical industry exports some 30 to 40 per cent of its total product. Sir Harry Railing, president of the British Electrical and Allied Manufacturers' Association, recalled recently that Britain's electrical exports totalled £190 million in 1951 and were expected to reach £210 million in 1952, which would be about 7 per cent of the country's total exports. He also recalled that Great Britain and the U.S.A. were the two greatest exporters of electrical equipment.



Vertical Waterwheel Alternators on Test

The following brief review purports to give but a few examples illustrating some aspects of the work of electrical manufacturers.

Generators

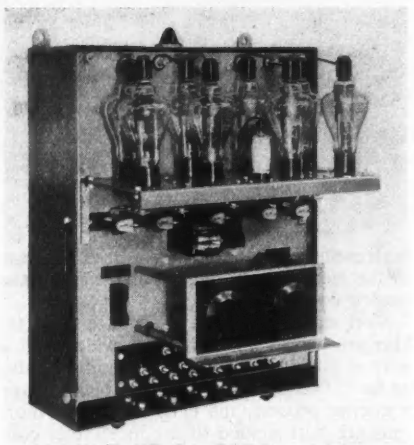
Among the heavy engineering plant completed by the British Thomson-Houston Company, Ltd., were the first three of six vertical waterwheel alternators for the Uganda Electricity Board's power station at Owen Falls. These machines run at the relatively low speed of 150 r.p.m., the output being 16·7MVA and the diameter over the casing 28ft. They are driven by Kaplan turbines and are designed to withstand an overspeed of 298 r.p.m. One of the alternators can be seen in the background of the accompanying photograph taken in the makers' works.

A special excitation system has been devised for these machines so that a high rate of response may be obtained readily despite the low alternator speed. To this end an electronic voltage regulator is used to control an "Amplidyne" pilot exciter supplying the field of a buck-boost exciter which is in series with the main constant-voltage exciter feeding the alternator field. A d.c. motor connected to the main exciter drives the buck-boost and amplidyne exciters. The main exciter is direct coupled to the alternator shaft and has sliprings whereby a.c. power can be supplied to the governor motor and electronic amplifiers. This arrangement, by eliminating the conventional pilot exciter and the permanent magnet governor alternator, allows the height of the main set to be reduced appreciably.

Another B.T.H. machine completed in 1952 was an 8500kVA synchronous condenser for installation in Bungsar power station, Malaya. A novel method of starting is used, the starting motor being an a.c. commutator machine fed from a three-phase, low-voltage source of supply at the substation. This motor is started as a slipring induction motor and its speed is then adjusted by moving the brush gear until the synchronous condenser is running at the correct speed. With this system the starting and synchronising procedure is simple, the starting motor power factor is high and the starting kilovoltampere load on the system is correspondingly low. This synchronous condenser is the first of its size to be used for voltage stabilisation under the control of a "Magnestat" automatic voltage regulator.

Further development work on the application of this type of voltage regulator for use in the B.E.A. generating station at Marchwood was carried out during the year. In the "Magnestat" voltage regulator the voltage to be controlled is compared with a magnetic reference and the voltage difference or error is amplified by a magnetic amplifier. The amplifier output excites an "Amplidyne" the output of which, in turn, feeds the main exciter field. There are no valves or relays in the regulator circuit.

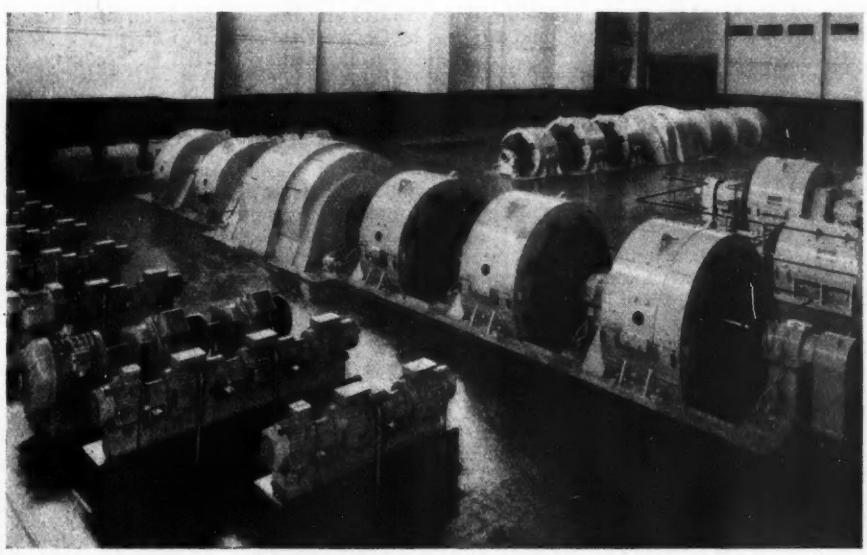
Another aspect of alternator performance that is of importance to the operator is the rotor temperature, and its measurement. This matter has been the subject of much investigation and, during the year under review, the General Electric Company, Ltd., introduced an indicator based on the determination of temperature by resistance measurement. In this instrument the ratio of rotor voltage to rotor current is indicated by a slow-speed motor-driven rheostat, which, under the control of a suitable magnetic amplifier and relay, is used in a self-balancing circuit. With this method of operation temperature indication is not influenced by fluctuating load, by the automatic voltage regulator, or by momentary transients.



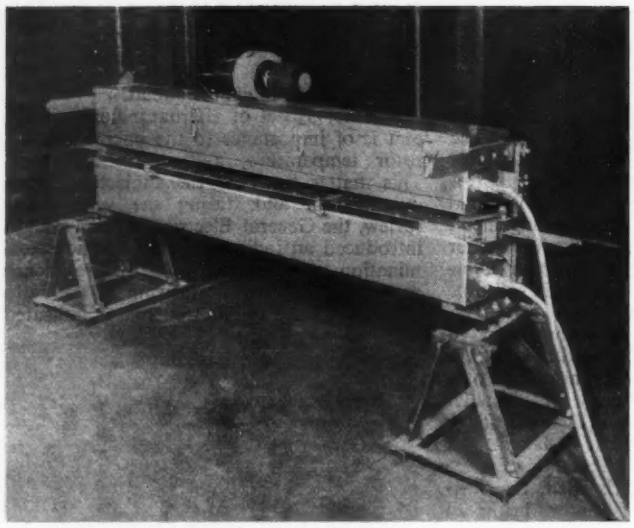
Grid Controlled Rectifier for Sidelay Control of Cloth Tentering Machine

Cold Reduction Mill at Trostre

The Trostre tinplate works, which was described in our issues of September 26th to October 10th, provides a good example of modern practice in the application of electric drives and controls in the primary metals industries. In the present review, we



Motor Generator Sets for Cold Strip Mill at Trostre



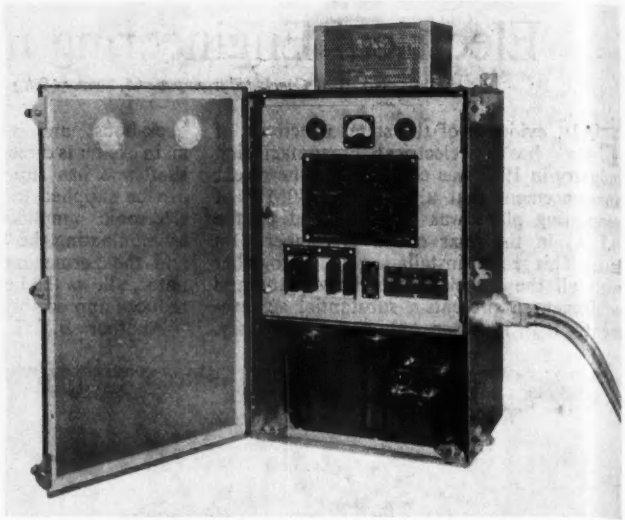


Photo-Electric Head and Control Panel for Pinhole Detection

shall confine out attention to a brief reference to the electrical equipment of the five-stand tandem cold-reduction mill.

Steel strip is received at Trostre from the Margam works in coils 38in wide, with a normal thickness up to 0·093in and weighing up to 15,000 lb each. After the pickling and trimming process, the ends of two or more coils are butt welded to produce larger coils with a maximum weight of 30,000 lb. These coils are then cold rolled to the finished gauge in the tandem mill. After rolling, the strip is cleaned, annealed and tempered. At this point the production line divides and coils intended for the hot strip mill tinning lines are side and end-sheared into sheets, whilst those intended for electrolytic tinning are side trimmed on the coil preparation lines. The finished tinplate from these two processes is the main product of the Trostre works.

The electric drive for the 48in five-stand tandem cold mill at the Trostre works consists of six direct current B.T.H. motors totalling 19,150 h.p. (one motor of 5500 h.p., one of 4000 h.p., two of 3500 h.p., one of 1750 h.p. and one of 900 h.p.). These d.c. motors are supplied from two B.T.H. motor generator sets having a total output of 16,730kW, each being driven by an 11,580 h.p. synchronous motor. An illustration on page 93 shows these motor generator sets and the associated " Amplidyne " and exciter sets.

Control of the mill is effected from a number of special control cabinets mounted on the mill housings. In the rolling of a coil, the motors are first run at a very low speed, while the forward coil end is fed through the stands and on to the reel. All the motors are then rapidly accelerated by raising the voltage of all the generators, the final speeds of all motors being determined by the setting of their individual motor field rheostats. As the coil nears the end, the speed of the motors is rapidly reduced by lowering the generator voltages and the tail of the strip runs out of the mill on to the coil. The coil is then removed from the reel and the mill is ready for the rolling of another coil.

Close accuracy in relative speed control of the motors is necessary, to avoid undue tension variations in the strip between the stands, and it is essential to maintain constant tension between the last stand and the reel, notwithstanding that the coil is steadily building up in diameter and, consequently, the reel motor correspondingly slowing down. These results are achieved by the use of " Amplidyne " exciters controlling each main unit.

The main characteristic of this mill is the unusually high speed of rolling—4500ft per minute, which is much greater than the speed of any previously installed cold strip mill in this country.

Mercury Arc Rectifiers

An interesting application of mercury-arc rectifiers is to be seen at the B.E.A. Huncoat power station, Accrington, where each of the two 30MW sets in service is associated with a system of automatic boiler control. The boiler-house auxiliaries are driven by d.c. motors and operate in conjunction with G.E.C. grid-controlled rectifiers in such a way that the heat input to the boilers automatically balances the load. Air and fuel admission are controlled to give maximum combustion efficiency. The system of control was developed in collaboration with Electroflo Meters Company, Ltd. Another B.E.A. power station in which G.E.C. grid-controlled mercury-arc rectifiers are associated with d.c. motor-driven auxiliaries is at Uskmouth, Mon. The total rectifier output is 17,000kW, and the electrical equipment operates in conjunction with automatic boiler-house control apparatus supplied, in this instance, by George Kent and Co., Ltd.

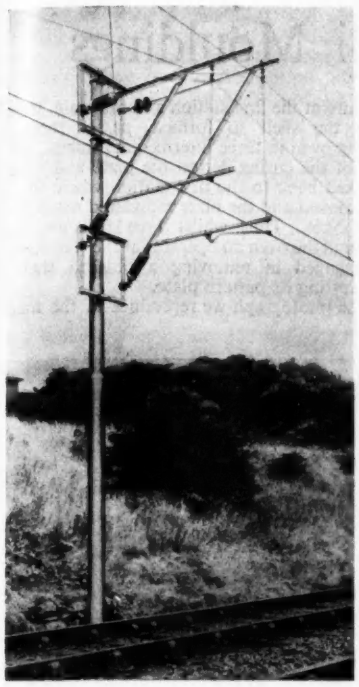
An installation of B.T.H. rectifiers for Uniao Fabril do Azoto, Portugal, is believed to be the first instance of the use of pumpless steel tank rectifiers for high-power electrolysis. Here, as in the 21,000kW pumpless rectifier installation for the Abbey works hot strip mill in 1951, special attention had to be given to the suppression or avoidance of interference by harmonics on the a.c. side. The problem was accentuated in the Abbey works by the continuous use of grid control and, in the Uniao Fabril do Azoto installation by the high ratio of rectifier load to generator rating and the substantial fifth and seventh harmonics in the supply voltage. The solution adopted was to use phase-shifting autotransformers to give sixty-phase operation in the first installation and twenty-four-phase operation in the second. In both instances the plant was designed with a view to maintaining accurate load balance. It is interesting to learn that both plants have experienced satisfactory load balance in service, and have been reported free from telephone interference or other disturbance, the overall input current waveshape being substantially sinusoidal.

Industrial Applications of Electronics

To illustrate the application of electronics to industrial processes generally, we propose to quote some examples of progress made by British manufacturers. One application concerns the textile industry, for which the British Thomson-Houston Company, Ltd., has produced a special scanning head for controlling the sidelay of cloth in a tentering machine. Two split-field series motors drive the mechanism for shifting the edges of the cloth under the control of four photo-electric relays. The company has now developed a special quadruple-grid-controlled rectifier to control the speeds of the two split-field motors. Independent adjustment of the speed of the two motors is achieved by two rheostats incorporated in the control equipment, as illustrated on page 93. The apparatus is designed to replace the electromagnetic contactors used hitherto ; sidelay control of the cloth was established by making about twenty corrections per minute and the frequent operation of the contactors gave rise to maintenance difficulties.

Another application concerns the sheet metals industries. Two B.T.H. photo-electric pinhole detectors were installed during the year at the Trostre works of the Steel Company of Wales. Each of these equipments consists of a photo-electric detector head and a control panel connected by two flexible armoured cables. As illustrated herewith, the detector head has two long compartments, one above the other ; the upper compartment houses twenty-four projector lamps and the lower one twenty-four photocells and an amplifier with a gain of 25,000. This equipment, with its control panel (illustrated herewith) is designed to be capable of detecting a pinhole of 0·010in diameter in a steel sheet 48in wide, travelling at 1000ft per minute.

An interesting development in spot or seam welding control was completed in 1952, and production should be available towards the middle of this year. In this B.T.H. control equipment the conventional resistance-capacitance timing circuit is replaced by two " Dekatron " scale-of-ten counting tubes. As applied to the spot welder these tubes count directly the number of cycles of power delivered to the welder—for the seam welder the number of cycles " on " and " off " are



Overlap Span with Double Cantilever Construction

counted separately. The required timing is set by switching in the selected cathode of the "Dekatron." This method of setting is positive and eliminates the troubles associated with drift of calibration of the weld timing control, caused by variations of supply voltage, temperature or other factors. The "Dekatron" tubes give a visible indication of the number of cycles counted, so that a check on the timing can be obtained readily.

An interesting example of electronic instrumentation as an aid to production is provided by apparatus known as the "Quantometer," which embodies a new system for metallurgical quality control. It allows accurate analysis of up to thirteen elements to be made in less than four minutes. Hitherto, in the production of special aluminium alloys which require close control of the alloying elements, it has been necessary to verify the composition of the metal after it has been cast. If the metal failed to meet the specification it was rejected for remelting and production was held up. With the new technique an analysis can be obtained before casting, while the metal is still in the furnace where corrections can be made to the composition.

The method is based on apparatus known as the "A.R.L. Production Control Quantometer," which is an electronically operated form of direct reading spectrograph. The apparatus, as illustrated herewith, consists of a sheet metal cabinet housing three main component assemblies—a source unit for exciting an arc or spark from the metal to be analysed; a spectrometer for measuring the intensities of the various wavelengths of radiation from the arc, and a recording console giving direct interpretation of the results.

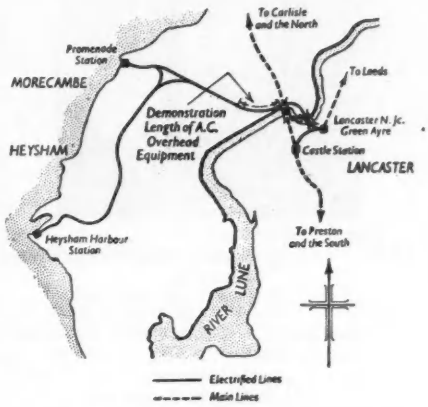
The operation of the apparatus begins with the preparation of test samples; they are cast at the furnace side, and undergo a high-speed machining operation to provide a pencil-shaped or flat plate specimen which is inserted in the source unit. An arc is then struck from the metal surface and the light is optically directed into the spectrometer, where the relative intensities of the component spectrum lines are measured by photo-multiplier valves. These valves charge condensers and the outputs are amplified to operate a high-speed recorder from which results are read and signalled to the foundry control centre.

The instrument described is installed in the foundry of T.I. Aluminium, Ltd., at Resolven, near Neath, South Wales. Because the operation of the instrument depends upon maintaining constant optical focus, the "Quantometer" is housed, under controlled temperature and humidity conditions, in a special laboratory in a corner of the foundry.

Electric Traction at 50 c/s, Single-Phase

Interest in electrical traction, using the industrial frequency of 50 c/s, has been stimulated by recent developments which have sprung from the initiative of French Railways in collaboration with a number of manufacturers on the Continent. Encouraged by the promising results of experimental work on French Railways, British Railways decided to provide, with the help of British manufacturers, a demonstration of 6·6kV, 50 c/s equipment, on the Lancaster–Morecambe–Heysham section of the London Midland Region. This section (shown in the accompanying map) was chosen for the experiment mainly because the electric rolling stock reached the end of its useful life in February, 1951, when the service reverted, temporarily, to steam operation.

It may be recalled that in 1908 the former Midland Railway Company introduced an electric service between Lancaster, Morecambe and Heysham involving electrification of 20 single-track miles. Originally, power was taken at 6·6kV, 25 c/s, single-phase, from the Heysham Harbour power station. Subsequently a 50 c/s supply was taken from the Morecambe Corporation Electricity Department and frequency changers were installed

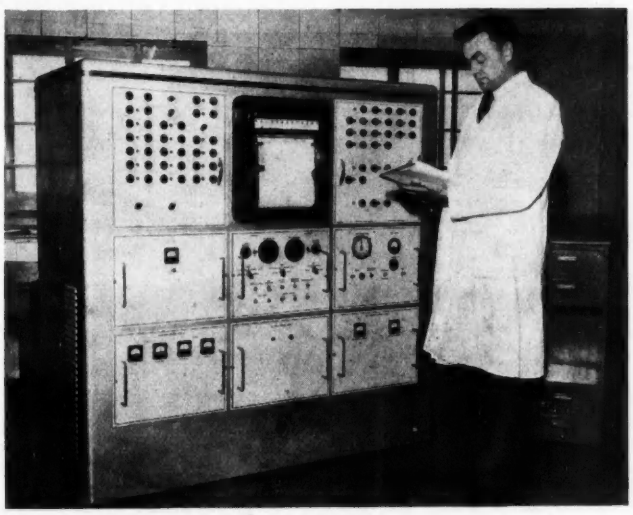


Lancaster - Morecambe - Heysham Line

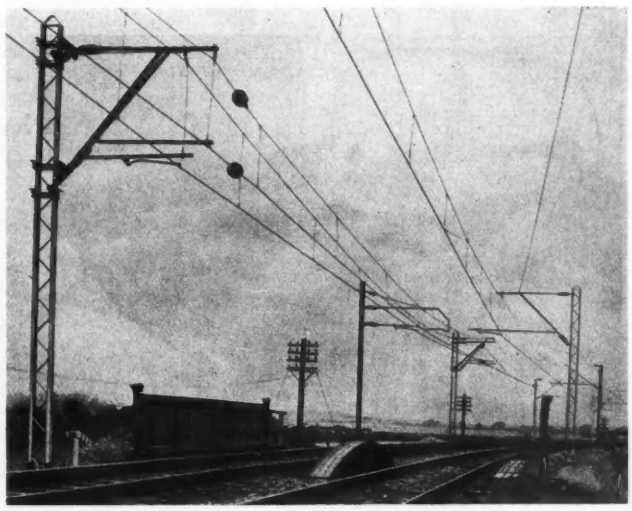
at Heysham to convert the frequency to 50 c/s.

At the time when the electric service ended the overhead equipment was of simple catenary construction consisting of a 7/0·080in stranded cadmium-copper catenary, with dropper wires supporting a single 0·108 square inch cadmium-copper contact wire. The normal structure carrying the overhead equipment consisted of a steel portal supported on wood poles set in concrete foundations.

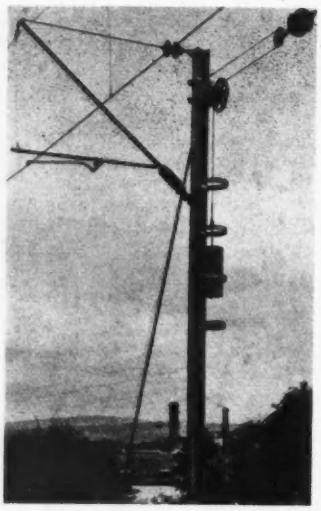
For the experimental demonstration of 50 c/s electrification traction equipment is being provided by the English Electric Company, Ltd., and the British Thomson-Houston Company, Ltd. For the new overhead equipment, British Insulated Callender's Construction Company, Ltd., has dismantled about 4000ft of the old two-track portal construction, and has substituted modern, light, single-track, hinged-lever cantilever structure. The design is such as to allow the system voltage to be raised from 6·6kV to 20kV for running



"Quantometer" for Metallurgical Production Control



Overhead Line Structures, Lancaster - Morecambe - Heysham Line



Balance Weight Termination on Stayed Broad Flanged Beam Pole.

trials by British Railways at the higher voltage, if required. The overhead equipment consists essentially of a 7/0·116in stranded, hard-drawn copper catenary, and dropper wires carrying a single 0·166 square inch cadmium-copper contact wire. Balance weights provide automatic tensioning.

For this demonstration length of track several different forms of supporting structures are being tried, including rolled steel joists, steel broad flange beams, aluminium broad flange beams, lattice steel (Painter Brothers, Ltd.), tubular steel, prestressed concrete and creosoted wood. The hinged cantilevers are fabricated either from steel angles and tees, steel tubes or aluminium alloy sections. Embodied with the various cantilever arrangements are pin, cap-and-pin and solid core insulators. To compare the effectiveness of various methods of protecting the masts against corrosion, twelve different types of protection have been adopted ; they include galvanising, flame cleaning and painting, shot blasting and metal spraying.

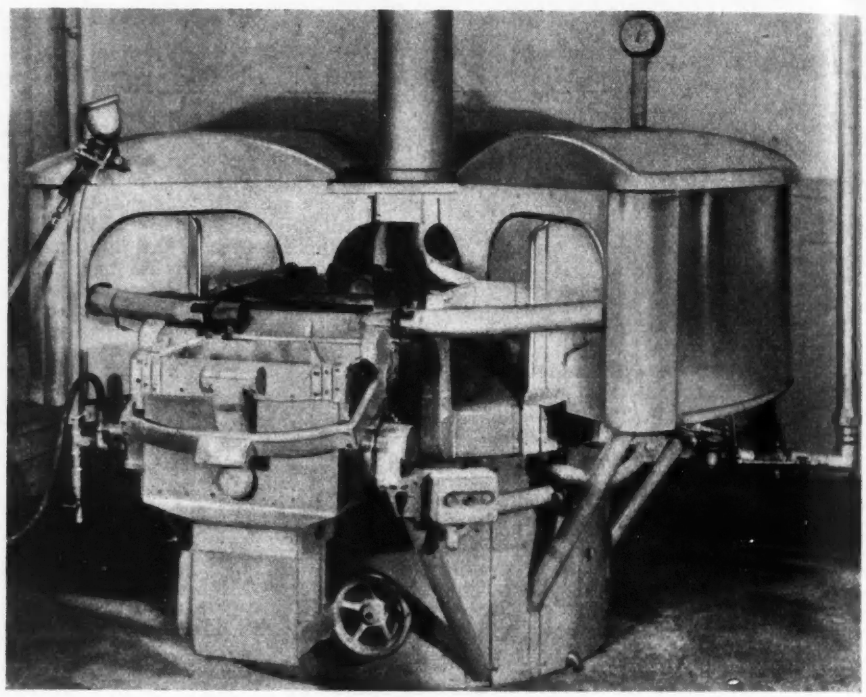
A few of the forms of construction are illustrated. One of the photographs on page 95 shows some of the structures ; on the left is an insulated overlap span on curved track, and, on the right, a mid-point anchor. We also illustrate a balance weight termination on a stayed, broad-flange-beam pole, and an overlap span using double-cantilever construction on a tubular steel pole.

Mechanised Shell Mouldings

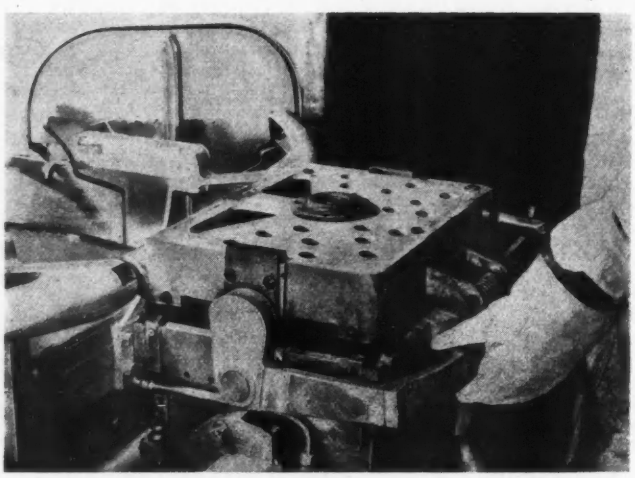
A FURTHER development in the shell moulding process has been made by the Polygram Casting Company, Ltd., Power Road, Gunnersbury, London, W.4, by the introduction of a new machine for the continuous automatic production of shell moulds. As is now generally known, this shell moulding process entails the production of mould shells by the application of a mixture of sand and a thermo-setting phenolic resin to a heated pattern on which the mixture builds up and forms a shell conforming to the contours of the pattern. The shell, after a suitable curing period, can then be stripped from the plate and assembled with other shells to form a complete mould.

The new Polygram automatic moulding machine is so arranged that during its mean cycle time of two minutes it produces the shells of four half moulds, or the equivalent of sixty complete moulds an hour. In the machine cycle a pattern plate is invested with the sand/resin mixture at the first station and the plate, together with the shell so formed, passes through a curing oven in three intermediate stages. At the end of the curing period the plate and shell are indexed back to the first station where the shell is removed and the plate reinvested ready for the next cycle. Thus, whilst three shells are passing through the oven an operator at the fourth station is engaged in removing a finished shell and reinvesting its pattern plate.

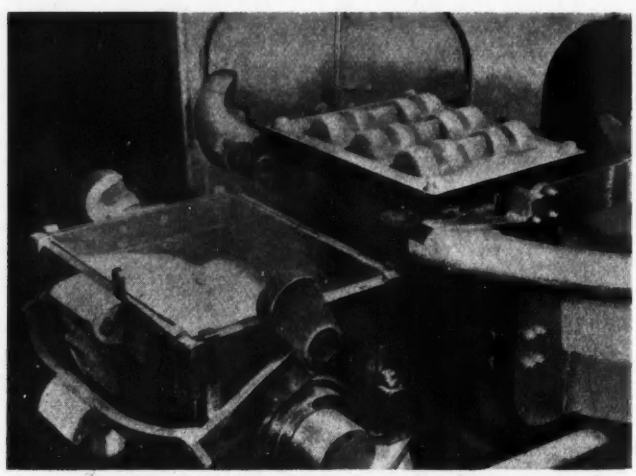
The photograph we reproduce of the machine on this page shows its clean compact design. The pattern plates are traversed round the machine by an annular carrier frame structure driven through a gearbox by a 1 h.p. motor. Automatic indexing ensures that a pattern plate stops in the correct position at the stripping and investment station at the front of the machine. Mounted on trunnions at the front of the first station is a counterbalanced, roll-over investment bin.



Automatic Shell Moulding Machine



Pattern Plate on Investment Bin



Shell Moulds Ready for Curing Cycle

Each pattern plate is assembled with a rigid cover plate which is supported in the carrier frame by a pair of hinge pins projecting from each carrier at the front and a second pair of pins at the sides. The front hinge pins register in slots in the front carrier rail and the side pins in slots in an intermediate member. The mounting of the pattern plate with the cover and the supporting method can be seen in illustrations on the opposite page.

In the cycle of operations when the pattern assembly reaches the investment station, the operator swings it upwards and forwards on the hinge pins and lowers it down on to the top of the investment bin. When the cover is in position on the top of the bin—with its pattern plate lowered a short distance into the bin—the front hinge pins are clear of the carrier rail. The operator then pulls up a locking bar on the front of the bin and a clamp at each side engages the intermediate support pins and locks the assembly firmly to the top of the bin. The bin is then rolled over and the sand/resin mixture it contains falls on to the heated pattern. A false bottom on the bin is mounted on a pneumatic ram and, with the bin in the inverted position, admission of compressed air to the ram forces this false bottom down to press the sand/resin mixture into close contact with all parts of the pattern contour.

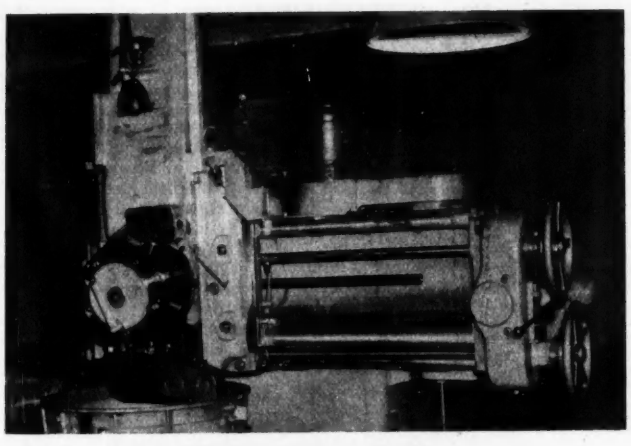
Whilst the bin is kept inverted the resin melts and a shell of the mixture adheres to the pattern, and at the end of a predetermined time, which is sufficient to build up the required shell thickness, the bin is swung back to its original position. The supply of compressed air to the false bottom ram is automatically cut off and its pressure released when the bin is restored to the upright position. The locking bar is then disengaged and the pattern, now complete with its shell of sand/resin mixture, is swung back on to the carrier. When the operator then depresses a push button the carrier is indexed round to transfer the plate assembly together with the shell into the curing oven. This indexing motion is interlocked and cannot be started until the support pins are fully home in their slots in the carrier frame.

It will be appreciated that as one assembly moves into the curing oven another assembly carrying a cured shell moves into the loading station. As this second assembly approaches the station the shell it carries is automatically released from the pattern by ejector pins so that the operator is able, without difficulty, to remove it from the machine. Once the finished shell is removed all that the operator has to do to prepare the pattern for the investment cycle is to apply a special stripper preparation with a spray gun. This stripper preparation plays an important part in the clean and easy removal of a shell at the end of the curing period. The oven is gas fired and is maintained at a constant temperature by thermostat control.

In the course of a visit to the makers' works to see the new machine, we were afterwards shown the moulds made on it in use in the foundry. Metal was being poured, with the two halves of a mould simply held together by means of clips and otherwise completely unsupported. As pouring was completed the hot metal ignited the resinous binder of a mould, which was rapidly burnt out. In many cases, before the metal had completely cooled, the mould material simply fell away to leave a clean casting free of any adherent sand.

Optical Control on a Machine Tool

AN interesting example of the adaptation of a standard machine tool for high-precision production work in the manufacture of aircraft engine components has been sent us by Alfred Herbert, Ltd., of Coventry. In this particular instance a Webster and Bennett 48in boring mill was tooled up and fitted with a Hilger projector and scale to enable the machine to be set quickly and accurately for machining a series of annular grooves in the bore of aluminium alloy compressor casings. Very close machining tolerances were laid down, the width, depth and pitching of the grooves being required to limits which would normally be difficult to maintain in quantity production when using the stops and dials provided on the standard machine. By using the optical equipment to locate the cutting tools, despite the fact that they cannot be seen by the operator, their movements can be accurately controlled and repeated without need for inter-operation inspection or measurement. With this equipment on the boring mill not only has the need for a special purpose machine been eliminated, but it is pointed out, a saving of 82 per cent has been made over the original machining method used for cutting the grooves. In the sequence of operations, the end of a casing is finished to the required length, the grooves are rough- and finished-machined, and then undercuts are rough- and finished-machined to provide the required "tee" form. The grooves vary in width, but are of the same form and diameter.

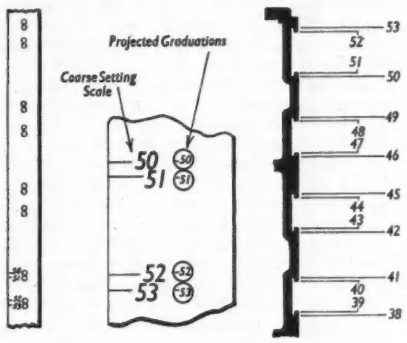


Boring Mill Equipped for Optical Control

The mill set-up can be seen in the photograph we reproduce on this page. Vertical settings of the turret slide, controlling the width and pitch of the grooves, are made by reference to a special scale fitted to the side of the slide with an optical projector having a magnification of ×25 on its screen and fitted to the saddle of the machine. The scale is engraved on a 1½in section bar of aluminium alloy similar to the material used for the compressor castings. As the reference scale bar and the castings have the same coefficient of expansion temperature changes in the shop do not affect the co-ordination of the set-up, one end of the bar being left free to slide in its dovetail guides as expansion or contraction takes place. The saddle is traversed along the cross rail of the machine to feed the tool into the work, the depth of cut being controlled with reference to a dial and pointer registering the amount of saddle movement.

Two sets of graduations are provided on the scale. One set is used for the quick preliminary positioning of the turret slide, and the other set in conjunction with the surface projector for precision setting. In one of the drawings we reproduce there can be seen the relationship of the scale to the casing. It shows one end of the scale on which the coarse setting graduation lines are engraved and marked with large figures. The fine setting graduations, which are projected, are set nearer the centre of the bar, and they are engraved on the lapped ends of a series of hardened steel rollers set in the bar. It will be noted from the section of the casing shown on the right of the drawing that the scale marking is the reverse of that on the casing grooves.

The first operation is machining the top face of the casing and the position of the first groove—that marked 51–52—is set relative to this top

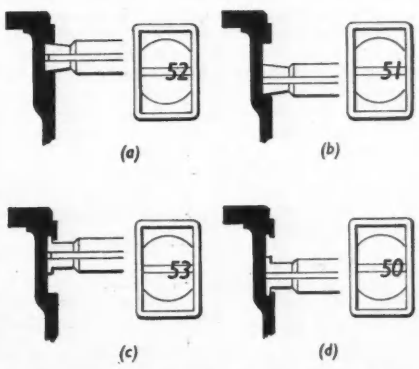


Setting Scale and Compressor Casing

surface. In this grooving operation two cuts are taken, as the width of the tool is only equal to that of the narrowest groove at the opposite end of the casing. The scale and the projector are then set in relation to these grooving operations, and this initial setting is retained for a batch of castings.

In the second drawing, the diagrams *a* and *b* show the relationship of the image projected on the screen and the cutting tool in respect to the work. When machining the top groove the operator positions the turret slide until the fine setting line numbered 52 is central between two white lines on the screen. The saddle is then traversed along the cross rail to the required depth of cut with reference to the dial and pointer indicating the amount of saddle movement. This pointer depth reading is maintained throughout the subsequent operations. The tool is then withdrawn and the turret slide fed down until the mark 51 is seen in position on the projector screen, when the tool is again fed into the required depth.

The groove 51–52 is thus rough formed and the operation is repeated until all the grooves



Relationship Between Projected Scale and Tool

below have been machined in relation to the scale. The grooving tool is then replaced by a double-edged undercutting tool and the slide is traversed up and down to machine the two undercuts, using the same scale and dial readings as in the forming cuts to locate the tool. As will be seen from the diagrams *c* and *d*, the depth of undercut is controlled with reference to scale markings on the projector screen. In the identical finishing operation the undercutting tools used are of greater width to take light cuts on all surfaces of a groove.

This method of machining was developed by Alfred Herbert, Ltd., Hilger and Watts, Ltd., and the aircraft makers; it can be employed for accurate control and setting of slide movements on most machine tools.

Handling Plant in Bauxite Ore Carrier

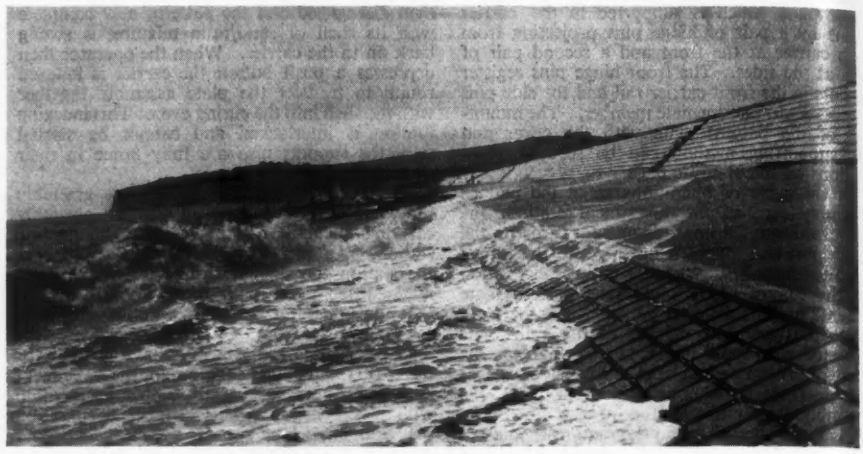
THE ore-carrying ship, "Carl Schmedeman," is the first self-unloading ore carrier to be used by the aluminium industry and is employed for transporting bauxite from Ocho Rios Bay, Jamaica, to Mobile, Alabama and Corpus Christi, Texas. The bauxite is carried in four holds which have a cross section, at the bottom in the form of a letter W, and the self-unloading system is at the base of each vee in the W. Designed to handle ore, with a maximum screen size of ¾in and weighing 66 lb per cubic foot, at a maximum rate of 1400 tons per hour, the conveying equipment has been built and installed by the Fraser and Chalmers Engineering Works of the General Electric Company, Ltd.

The two-hold conveyors, the main details of which are shown in our line drawing, are arranged horizontally in way of the holds and then inclined through trunks, built in the engine and boiler-rooms, to main deck level, at the aft end of the ship, where they discharge on to a transverse belt shuttle conveyor. This can be extended through doors in the ship's side to port or starboard to discharge to a shore receiving plant.

At the base of each vee, in the holds, a total of 152 specially designed hopper gates are fitted, which are operated by a handwheel through gears and chain on grooved drums, to feed the ore by gravity to the two conveyors of Robins design. The conveyor belts, each 397ft long by 42in wide, are of cotton impregnated with rubber and rubber covered, and operate on 42in three-pulley, roller-bearing troughing idlers. These are placed at about 2ft centres under the holds, beyond which the conveyors rise 38ft with the idlers spaced at approximately 3ft apart. The unladen weight of each conveyor is about 28·5 tons and the gates and operating gear weigh approximately 100 tons. The maximum capacity of both conveyors is 1400 tons per hour at a belt speed of 360ft per minute. Each conveyor is driven through reduction gears, having a ratio of 9·733 to 1, flexibly coupled to a totally enclosed, fan-cooled, dustproof G.E.C. electric motor running at 1750 r.p.m. and having a continuous rating of 100 h.p. The electrical supply is 440V, three-phase at 60 c/s.

As already mentioned, each hold conveyor discharges to a reversible shuttle conveyor mounted athwartships and arranged to discharge, either to port or starboard, through side doors. This conveyor has a length at rest of 37ft 6in and is extended, pneumatically, a distance of 11ft 3in through the ship's side. The belt, 48in wide, is carried on 48in, three-pulley, roller-bearing troughing idlers, and at a speed of 515ft per minute is capable of handling the maximum output of both hold conveyors. A G.E.C squirrel-cage, totally enclosed, fan-cooled, dust-proof, 440V, three-phase, 60 c/s, reversible electric motor running at 1750 r.p.m., and having a continuous rating of 20 h.p., drives the conveyor through reduction gears having a ratio of 15·6 to 1. In addition to the motors, the General Electric Company, Ltd., has supplied the starters and two 10in Witton-Kramer solenoid brakes for the two 100 h.p. motors, and the control equipment for the 20 h.p. motor.

The "Carl Schmedeman," was built at the Barrow Works of Vickers-Armstrongs, Ltd., and delivered to Reyolds Jamaica Mines, Ltd., towards the end of last year. A deadweight of 13,150 tons is carried and the ship has a length overall of 518ft.



Pett Sea Wall

Coast Protection at Pett, Sussex

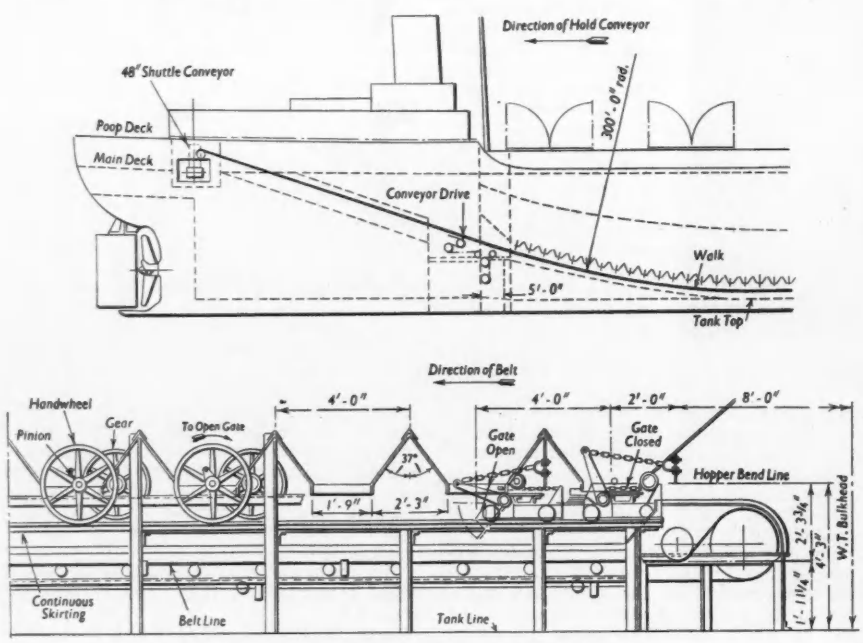
CONSTRUCTION of the Pett sea wall was commenced for the Rother and Jury's Gut Catchment Board in 1947 and completed for their successors, the Kent River Board, last year. The works are actually in Sussex, east of Hastings and west of Rye Harbour, and protect the reclaimed Pett Level, the main road and rail communications.

Works of sea defence in the area are of great antiquity, and Dugdale mentions a breach in 1293. The immediately past defences which the new wall supersedes were of Douglas fir, which decayed where not frequently covered with water, but other parts consisting of groynes and a wave screen have been retained. The new works consist mainly of a sea wall 3 miles long with an access road behind. The wall is essentially of clay dug from the marsh behind and is protected from wave action by a thin flexible covering of concrete blocks set in a bituminous mixture and of sheet asphalt. The toe is provided with a line of steel sheet piling.

A flexible covering was deemed essential, as the wall rests on a marsh foundation of clays, silts, sands, and peat overlaid in places with beach, and settlement over short and long periods had to be accommodated. The cross section of the wall varied with the foundations keeping the same outward profile of a lower slope, a wide berm at highest tide level, and a steep high back wall. The lower slope and the back wall are of clay, the berm is of any handy material, usually clay or beach or both. Where not too deep, the clay sections were keyed into the marsh clay below. On some lengths this was not economically possible and there the clay was placed in the beach, but to prevent any possibility of leaching away a thin layer of bituminised sand was interposed. The clay was consolidated by bulldozer. The back slope was soiled, seeded and sprayed with cold emulsion to ensure early growth.

Concrete blocks were made on the site. At first some available 1ft by 1ft by 6in blocks were used and some more made for the lower slope, and then for most of the wall 2ft by 2ft by 8in blocks, crane-laid, were used. The back wall had 1ft by 1ft by 4½in blocks throughout. As severe abrasion occurs on the lower slope, it was considered that the concrete should be resistant, and the strength was assumed to be a measure of that property. By use of a nominal 3 : 1½ : 1 mixture gap-graded, with a low water cement ratio and with heavy table vibration, blocks were consistently turned out having test cube strengths of 8000 lb per square inch at twenty-eight days. A bitumen-sand-asbestos jointing was mixed in oil-fired boilers on the site and poured by hand. The berm asphalt was supplied from a road depot and was ordinary two-coat road asphalt, except that it was kept more flexible, as it was not laid on the ordinary rigid foundation.

Despite the height of the wall, it was overtopped by the rare combination of wind and tide which produced extraordinary results on the South Coast in December, 1951. Slips occurred on the back slope, but no other harm resulted. The contractor was Mears Brothers Ltd., of Sydenham, and the sub-contractor for the asphalt work was Chittenden and Simmons, Ltd. The consulting engineer for this work was Mr. C. H. Dobbie.



Conveyor System for Unloading Ore Carrier "Carl Schmedeman"

BRITISH REFRIGERATION ASSOCIATION.—The British Refrigeration Association announces that its annual luncheon will be held at the Connaught Rooms, Great Queen Street, London, W.C.2, on Friday, March 20th, at 12.45 p.m., when the principal guest will be Lord Llewellin.

Double Tetrode Valve for New U.H.F. Wavebands

A HIGH performance double tetrode, for use on the new u.h.f. wave-bands, recently allocated for business radio, radar-sonde and television-link equipment, is now being marketed by Mullard, Ltd. It is the "QQV03-20" valve and is intended for wide-band operation as an r.f. Class "C" power amplifier or multiplier in low-power mobile transmitters working at frequencies up to 600 Mc/s. At 200 Mc/s the new valve is capable of providing a power output of 42W. Under reduced input conditions 22W can be obtained at 400 Mc/s and approximately 12W at 600 Mc/s. The valve is designed for high anode efficiency, power gain, low filament consumption and small physical dimensions; being of "all-glass" construction, it does not require the complex "circuitry" normally associated with existing u.h.f. valves of this class. It is constructed on the "B7A" base.

Hose-Laying Fire Engine

THE hose-laying fire-engine illustrated below, has been supplied by Merryweather and Sons, Ltd., Greenwich, to augment the rapidly developing Fire Service in Trinidad, British West Indies.

The machine can carry over a mile of 3½in rubber-lined canvas hose, which can be laid in a double line. The hose is stowed already coupled and is carried "flaked" in a series of long, narrow compartments which form the rear section of the vehicle. The hose is reached from the rear by opening two hinged flaps; the lower flap carrying castoring wheels, serves as a trailing platform over which the hose is paid out. The operator can maintain contact with the driver by a push-button bell. The rear platform is illuminated at night.

Access to the roof is gained by a ladder sunk within the bodywork on each side of the chassis. On the roof, immediately to the rear of the monitors, are hinged, water-tight covers. Opening these covers enables the hose compartments to be reached from above and thus simplifies the task of stowing the hose.

Roof-mounted monitors for delivering water are unusual in this country. This machine carries two such monitors and each is independently capable of delivering up to 700 gallons of water per minute. The water is fed to the monitors (both have independent shut-off valves) from the Merryweather 1000 g.p.m. turbine pump which is mounted amidships and driven by a take-off from the main gearbox. Operating controls, suction inlet and delivery outlets are positioned on both sides of the machine. Suction hose is carried in special pockets arranged beneath the main hose-carrying section at the rear. The pump duties are given in the accompanying table.

The bodywork is of English ash framing plated in aluminium. Crew accommodation provides for driver and officer in the front, placed well forward to give a good view of the road, and a seat behind for a fireman technician. There is additional locker space, and provision is made for a 3000-gallon collapsible dam.

Included in the equipment are two reels carrying field telephone cable, each holding 3000ft.

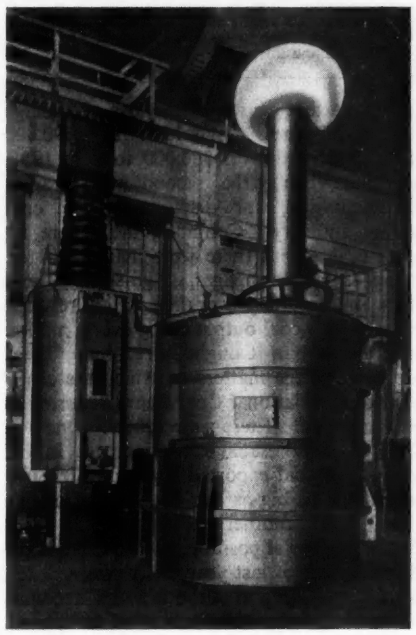
The chassis is a Merryweather/A.E.C. based on the "Regent, Mk. III" and incorporates a rear axle stabiliser, which prevents undue "roll" when the machine corners at speed. The six-cylinder diesel engine develops 125 b.h.p.

	At pounds per square inch
1,000 imperial gallons per minute	80
950 imperial gallons per minute	100
850 imperial gallons per minute	120
775 imperial gallons per minute	140
700 imperial gallons per minute	160
600 imperial gallons per minute	180

(The pump is capable of working up to 200 lb per square inch with reduced quantities.)

Impulse Tests on Prototype 275kV Transformer

A DEMONSTRATION was given recently at the Trafford Park works of Metropolitan-Vickers Electrical Company, Ltd., of the impulse voltage withstand levels of a prototype of the eight 120MVA, 132/275kV, three-phase, auto-transformers being built for the British Electricity Authority. Representatives of the B.E.A. and of Messrs. Merz and McLellan and Messrs. Kennedy and Donkin, consultants to the Authority, were present at the demonsration.



Prototype 132/275kV Transformer on Test

The prototype consisted of a full-scale leg of windings, complete with tappings, mounted on the centre leg of a special three-legged testing core and connected to a type "H" single-phase, eighteen-step tap-changer, with resistor transition. It may be recalled that the type "H" tap changer was developed by the company some years ago for use on fully insulated high voltage systems. The highest-voltage class in operation is 150kV fully insulated, where the power frequency test was 330kV for one minute and the impulse withstand voltage was 800kV (crest).

The transformers will be star-connected 132/275kV auto-transformers, with tappings covering a range of 30 per cent in eighteen steps, located at the 132kV line point. The tappings will be connected to three single-phase tap changers, mounted on the tank side, which form the 132kV terminals of the transformers.

A general view of the prototype arranged for the demo nstration at the company's test plant is reproduced herewith. The impulse withstand level was demonstrated by the application of the following shots in addition to the calibration shots: (1) at the 132kV terminal—one 550kV crest, full wave; two 640kV crest, chopped waves; two 550kV crest, full waves. (2) At the 275kV terminal—one 1050kV crest, full wave; two 1200kV crest, chopped waves: two 1050kV crest, full waves.

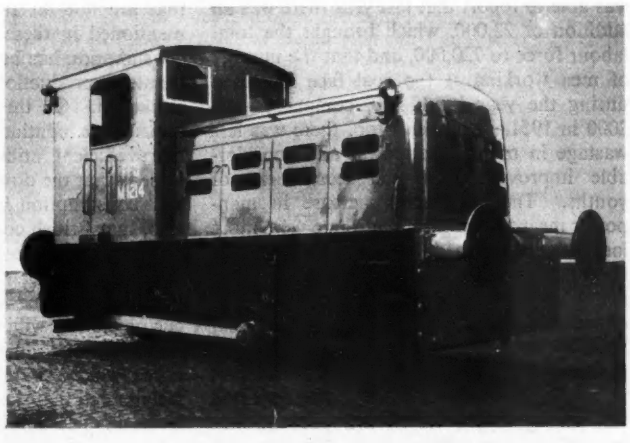
Diesel Locomotives for Denmark

WE illustrate on this page one of two 100 b.h.p., 0-4-0, diesel mechanical locomotives recently completed by John Fowler and Co. (Leeds), Ltd., and dispatched to the Aalborg Railway in Denmark. These locomotives have been built for 4ft 8½in gauge track and in full working order weigh some 19½ tons.

The locomotives are each fitted with a Leyland six-cylinder direct-injection oil engine developing 110 b.h.p. at 1700 r.p.m. intermittent rating. Drive is transmitted through a servo-operated friction clutch and a transfer gearbox and flexible coupling to a Fowler four-speed gearbox, and then through reversing bevels, spur reduction gearing and jackshaft to the wheels. At normal engine revolutions the four speeds transmitted through the gearbox are 3, 5, 7½ and 11 m.p.h., giving corresponding maximum tractive efforts of 10,715 lb, 6550 lb, 4100 lb and 2720 lb. The manually operated change speed gear through the makers' synchromesh gearbox is stated to be positive and smooth. To facilitate operation the controls for the engine, air brake, clutch and sanding are duplicated on each side of the driver's cab. A dead man control is fitted, to brake the locomotive should the maximum real speed be exceeded.

The mechanical structure of the locomotives is built up on 1¼in thick plate frames tied together by substantial cross members and 1¼in thick buffer beams, which are supplemented at the ends by 3in thick beams. The locomotive illustrated is fitted with normal British three-link couplers for test purposes but screw couplings were fitted for service in Denmark.

Hose Laying Fire Engine



Diesel Locomotive for Aalborg Railway

THE ENGINEER

Vol. 195 JANUARY 16, 1953 No. 5060

LEADING ARTICLES—

Coal Prospects ... 100
Small Firm ... 100

ARTICLES—

Aeronautics in 1952. No. III. (Illus.) ... 91
Aluminium Grain Silo. (Illus.) ... 108
British Standards Institution ... 81
Chalk Crushing and Screening Plant. (Illus.) ... 115
Civil Engineering in 1952. No. III. (Illus.) ... 82
Coal in 1952. No. II ... 106
Coast Protection at Pett, Sussex. (Illus.) ... 98
Conference on Engineering Education ... 102
Diesel Locomotives for Denmark. (Illus.) ... 99
Double Tetrode Valve for V.H.F. Wavebands ... 99
Electrical Engineering in 1952. No. III. (Illus.) ... 93
Engineering Maintenance in Iron and Steel Works ... 81
Foundries and the Iron and Steel Bill ... 81
Fundamental Techniques in Transport ... 81
Gas Turbines in 1952. No. I. (Illus.) ... 86
Handling Plant in Bauxite Ore Carrier. (Illus.) 98
Hose Laying Fire Engine. (Illus.) ... 99
Hydraulic Motor. (Illus.) ... 114
Impulse Test on Prototype 275kV Transformer. (Illus.) ... 99
Mechanised Shell Mouldings. (Illus.) ... 96
Metallurgical Developments in 1952 ... 109
National Coal Board's University Scholarships 81
Naval Construction in 1952. No. III. (Illus.) 110
Optical Control on a Machine Tool. (Illus.) ... 97
Portable Power Loader. (Illus.) ... 116
Reducer Rolls. (Illus.) ... 115
Royal Navy 1952. No. III. (Illus.) ... 89
Shipbuilding and Marine Engineering in 1952. No. III. (Illus.) ... 102
Specialist Team on Industrial Engineering ... 81

LETTERS TO THE EDITOR—

Atomic Energy ... 101
Coalbrookdale ... 102

LITERATURE ... 101

NEWS AND NOTES—

Books of Reference ... 113
British Patent Specifications. (Illus.) ... 119
British Standards Institution ... 116
Contracts ... 118
Forthcoming Engagements ... 120
French Engineering News ... 116
Industrial and Labour Notes ... 117
Launches and Trial Trips ... 120
Notes and Memoranda ... 118
Personal and Business ... 118

COAL PROSPECTS

The statement on the coal situation, which was made a week or so ago by Sir Hubert Houldsworth, chairman of the National Coal Board, has been received with mingled feelings of satisfaction and concern. Satisfaction because the total coal output in Great Britain last year was 226,500,000 tons, or about 3,600,000 tons more than in 1951, and concern because the coal prospects for this year do not at the moment appear to be so favourable. Ever since the serious fuel crisis of 1947, it has become customary at this season for the Coal Board to exercise a great deal of caution in attempting any appraisal of the year's prospects. In general, such an attitude is to be commended. In any attempt to assess the coal prospects during coming months, caution is to be preferred to a spate of optimism; for optimism, unless fully justified, could lead to serious consequences for industrial and, indeed, for all, consumers of coal.

Sir Hubert's latest statement was certainly not over-optimistic. Dealing with performance in the last calendar year, he put coal production from the deep mines at 214,350,000 tons, and said that the increase, compared with 1951, was obtained in the five-day week rather than as a result of the Saturday shift. About manpower, Sir Hubert was able to report that last year there was an addition of 22,000, which brought the total labour force to 720,000, and that the number of men working at the coal face increased during the year by 12,000, compared with 2000 in 1951. Last year, too, there was less wastage in mining manpower and considerable improvement in the recruitment of youths. The substantial increase in manpower meant, of course, that there were more inexperienced men at work in the mines, a factor influencing the fall in productivity which became apparent before last year ended. In 1946, coal output per man-year was 260 tons. From that low figure it rose steadily to 303 tons in 1951, and Sir Hubert admitted that "it was a disappointment that this steady improvement did not continue in 1952." Last year, output per man-year fell back to 300 tons, a reduction which was to some extent caused by the loss of tonnage through disputes. That loss was 1,390,000 tons, compared with 800,000 tons in 1951, last year being the second worst, since nationalisation, for disputes in the coal mining industry. Certainly, there were no large strikes, but there were many—far too many—small stoppages, "go-slows" and bans on Saturday working which resulted in last year's coal output being over a million tons lower than it might have been. These are some of the matters on which the chairman of the National Coal Board reported in his statement. There were others. One was "a reasonably satisfactory increase in the amount of coal exported last year, although it was not as big as had been hoped at one time," and another related to the Coal Board's financial position. By the end of the third quarter of last year, there was a deficit of £3,500,000, and although the accounts for the fourth quarter are not yet completed, it is clear that a deficit will be shown on the full year's operations. The Board has not been able to meet its rising costs—mainly in the form of higher wages and higher prices of materials—even though the average pithead price of coal has been increased by 10s. a ton in the last two years.

At the moment, unlike the early months of several preceding years, there is no serious shortage of coal. Some of the reasons for that are not far to seek. They have been mentioned in these columns before. Home consumption has been lower, because, unfortunately, production in some industries has slackened. On the other hand, fortunately, industry is continually bringing about the more efficient utilisation of coal. But the hope is that the downward trend in industrial coal consumption has stopped. It is hoped, also, that British coal will move more rapidly towards the place that it once occupied in the export market. Yet it cannot do so unless it can be offered at prices which overseas customers are willing to pay. Furthermore, industrial and domestic coal consumers at home would be relieved were they able to feel assured that the price of coal had reached its peak. The solution, of course, remains in a bigger output of coal at a consequent lower output cost per ton. This year, as Sir Hubert Houldsworth pointed out last week, the miners will be taking a second week's holiday. That alone can mean a loss of output amounting to as much as 4,000,000 tons. But a considerable improvement in the output curve for the five-day week and the loyal continuation of the Saturday working arrangements, taken in conjunction with the growing experience of the younger men now at work in the mines, may ensure that this year's coal prospects become much brighter than they appear to be at present. Certainly, the Coal Board's tasks are no enviable ones. It must improve its deteriorating financial position, it must endeavour to proceed with its development programme—despite the limitations upon capital expenditure—and, above all, it must see to it that more coal is produced. It is not unreasonable on the part of private industry, whose tasks to-day are no less enviable, and of the coal-consuming public, to expect the Coal Board to succeed.

THE SMALL FIRM

There must be few managements of industrial concerns, small and large, which are not frequently harassed by the rendering of returns of one kind or another for the preparation of statistical data. No one, so far as we know, has yet attempted the formidable task of computing the number of man-hours expended annually in paper work of this nature. From even the smallest business to-day, figures are called for by Act of Parliament or by the request of trade associations or other organisations which deem it desirable to build up a statistical picture of the economic and industrial situation. The increasing amount of form-filling and other paper work thereby entailed has compelled many firms in recent years to add to their clerical staffs. It has also compelled the owners or managers of many smaller businesses to burn far more midnight oil than is good for them, and perhaps has led them often to think that they "have toiled all the night and have taken nothing!" But setting aside the occasional criticism of statistics and their compilation, most of them, at any rate, serve some useful purpose. They enable the state of industry, and indeed the state of the nation, to be assessed; they also indicate industrial and economic trends which might not otherwise be given the emphasis they merit.

We are drawn to make this latter comment about the usefulness of statistics after a perusal of an analysis of the size of manufacturing firms in the United Kingdom, which appears in the December number of the *Ministry of Labour Gazette*, and to which brief reference was made in our issue of January 2nd. Under the provisions of the Statistics of Trade Act, 1947, the owner of every manufacturing establishment with more than ten employees is required to supply monthly, to the Ministry of Labour, information concerning the nature and extent of the employment in that establishment. It should be said straight away that the Ministry has prefaced its analysis with an acknowledgment of the excellent co-operation of employers in the matter. The analysis is based on returns made in May last year, information being received from 56,638 manufacturing establishments. The figures reveal that, of the total, 42,644 establishments, or 75 per cent, had less than 100 employees, and 8364 establish-

ments, or 15 per cent, had between 100 and 249 employees. The percentages in these two groups, it is observed, are much the same as those revealed by the Ministry's last similar analysis, published just over two years ago. In the large manufacturing establishments—those employing 2000 or more—there has been some change. At the beginning of 1950 there were 342 firms in that category, a number which by last May had increased to 361. But, as the Ministry of Labour explains, the total number of returns considered in the present analysis is greater. Our particular interest, however, is in the industry group headed "engineering, shipbuilding and electrical goods," which is by far the largest of the manufacturing groups included in the analysis. Here, returns were received from 8563 establishments, only 120 of which were each employing 2000 or more people last May. There were 2303 of these establishments which each had between eleven and twenty-four employees, and 3579 each with between twenty-five and ninety-nine employees. In other words, there are 5882 firms in the engineering industry—approximately 69 per cent of the total—each with labour forces of less than 100. Even though the regular preparation of such returns as these may be an additional burden on the managements of smaller firms, the resulting information, when collated, is illuminating. It certainly underlines the valuable contribution that is being made to the total product of the engineering industry by those who continue their businesses in a comparatively small way. That, of course, is in no sense a reflection upon the equally valuable quota of the large firms. By the continual expansion of their buildings and equipment, and by the increasing proportion of their resources which they readily devote to research and experimental work, they are always adding to the quality and output of British engineering manufactures. At the same time, it is encouraging to remember that so much of our engineering industry had its beginnings in workshops housed in garret, cellar or garden shed!

But the small firms, like the large, have their problems. To-day, there are numerous small concerns which are engaged in subcontracting work of various kinds and in the production of essential components. Their facilities for research and development work are severely limited, and their anxieties over procuring necessary material supplies are no small ones. In many instances, too, the work of the small firms is carried on in buildings that can no longer be called modern and with plant that has seen its best days—matters that they would like to correct were their burden of taxation lighter and were more capital available to them. Moreover, their share in the export drive may not be readily apparent and may not be, at present, nearly as big as they themselves would like. On this last count, it is good to learn, from a speech made last week at Wolverhampton by Mr. Duncan Sandys, the Minister of Supply, of the Government's intention to give every assistance to small firms to achieve an important addition to the country's engineering exports. Yet, despite all the problems with which they may be faced, the thousands of small engineering concerns in these islands are maintaining an important place in our economy. Individually and collectively, they are making a worthwhile contribution not only to the output, but also to the craftsmanship, and high technical standard, of British engineering.

Literature

Soil Mechanics for Road Engineers. By THE ROAD RESEARCH LABORATORY, (Department of Scientific and Industrial Research). London: Her Majesty's Stationery Office, Kingsway, W.C.2. Price 30s.

THE lack of an adequate textbook has been one of the reasons for the comparatively slow application of soil mechanics in the field of road and airfield design and construction. The information that was available was scattered through a large number of journals and reports and, as a result, the practising engineer was left in ignorance of many of the advances that had taken place. In expanding their lecture course into a textbook, the staff of the soil mechanics section of the Road Research Laboratory have made a useful contribution to the understanding of the fundamental aspects of road-making.

The authors cover in considerable detail most of the soil problems likely to be encountered, and methods in common use in the United States of America, where much of the development work has taken place, are fully described. It is of interest to see the wide divergence of approach of different authorities to the various problems and it is apparent that there is still considerable scope for further research. The authors realise that in some cases no completely satisfactory solutions have yet been found, but they indicate the lines that should be followed.

The book is well illustrated, and a great many experimental results are presented to show the relationship between the theoretical approach and the practical application. The chapters on soil stabilisation will prove useful to those concerned in low cost road construction, which is receiving attention in many of the less heavily developed parts of the world.

A general criticism of the book is that, in the attempt to describe fully the various procedures that are in use by various authorities, the authors fail, in some cases, to emphasise the really important points and the reader is left rather confused by the mass of detail.

World Railways, 1952–1953. Edited by H. SAMPSON. London: Sampson Low, Marston and Co., Ltd., 25, Gilbert Street, W.1. Price £4 4s.

WHEN the first edition of this book was published a little more than eighteen months ago its success was assured, for no book with such a wide scope had ever before been printed on railway matters, and it gave a mass of detailed information, much of which could only be obtained with some difficulty and generally only by lengthy and costly research. At that time the publishers were under the impression that the book would serve its purpose for a number of years, but within a very short time a number of factors made it desirable to put this revised edition in hand. Not only did the first edition have an enthusiastic reception from railway engineers and other officials, but a mass of official data was received concerning hundreds of railways on which little information had been available for the first book, and there had also to be taken into account the development of railways throughout the world.

The new volume is arranged on similar lines to its predecessor and incorporates a vast amount of authoritative information based upon notes received from official sources. It gives details of practically all of the leading railway systems of the world and some hundreds of the smaller lines. The particulars given of 1447 railways in 101 countries is supplemented by 125 maps and more than 850 excellent photographs and drawings. The sections covering each important railway include notes on the gauge, length, stock and general statistics; history; area served; method of train control and signalling; track details; noteworthy facts such as tunnels, bridges, &c.; representative locomotive types and rolling stock, &c.

As already pointed out, this second volume contains a vast amount of new information, and in it certain inaccuracies, which appeared in the first edition and are unavoidable in a new work of this kind, have been corrected. Most of the gaps which occurred in the information and data presented in the first edition have also been filled.

An interesting foreword to the book gives a series of brief reviews of the trend of development in various countries, particularly in connection with locomotives and rolling stock. This foreword concludes by expressing an opinion that, in general, in spite of the difficulties of maintaining economic operation, the world's transport systems are handling the ever-increasing volume of traffic in a satisfactory but by no means complacent manner.

The first edition of this book filled a long-felt want in railway literature, and this new edition, with its revisions and additions, provides an invaluable and up-to-date reference work for all connected with railway administration and construction, as well as for manufacturers of railway equipment of all kinds. All who are interested in the history and development of railways will never cease to regret that it was not until 1951 that the first volume of this work was published. Had a series of volumes of this nature been published in past years they would have provided an invaluable record of the growth of the railway systems of the world.

Letters to the Editor

(We do not hold ourselves responsible for the opinions of our correspondents)

ATOMIC ENERGY

SIR,—In your article in the January 2nd issue on "Atomic Energy in 1952," you indicate the possibility of the uranium reaction being available for civil purposes after the risk of it being diverted to other uses has been mastered, and by this I understand you to mean until a time is reached when information can be safely divulged which at the moment could be used against this country.

The static position of our drive for a national fuel policy, and the disappointments of the Ridley report, only makes it even more essential that we should investigate every possibility of increasing the power efficiency of the country without delay. The prospect in the field of electrical generation alone is grim, the B.E.A. only envisaging an efficiency increase up to 29 per cent by 1965. Any increase in generating capacity will therefore only worsen our general power position if coal is still regarded as the basic fuel for electrical generation. In view of this, is it too visionary to suggest that we should look forward in 1953 to a policy designed to bring the Ministry of Fuel and Power into close co-operation with the Government Atomic Energy Research Establishment, and the beginning of positive investigations into the possibility of using the uranium reaction for power genera-

tion. One wonders whether, when planning the palatial generating stations now being erected, often on congested sites, such as Bankside, any consideration is given to space requirements for an atomic pile. If not, the capital costs of conversion in the future will be far greater than they would be if such a policy as is outlined above was developed.

It is becoming obvious that we are entering a new era of industrial power development, and the Government-encouraged atomic research means a rapid advance in this respect. Should we not ensure that we benefit from this with the least possible delay and disruption ? Success would mean a national prosperity we dare not even dream of to-day.

R. A. DUCKWORTH, A.M.I. Plant E.

Romford,
January 9th.

COALBROOKDALE

SIR,—Many thanks for your Christmas card, in which I was particularly interested. My old home was at Coalbrookdale, where my father was Vicar for about thirty years, and I know the old ironworks very well. When I was a boy, I can quite well remember the narrow gauge railways on which they used horses for drawing small trucks. These were flat rails with flangeless wheeled trucks, and I should say about 21in or 24in gauge. I should also like to congratulate you on the article which appeared in THE ENGINEER last year on the subject of " Trevithick's First Locomotive," which is now thought to have been built at Coalbrookdale.

T. A. CROWE

Glasgow,
December 22nd.

[The Christmas card referred to carried a coloured engraving of a picture by Loutherbourg entitled " Coalbrookdale by Night." A black and white reproduction of that picture, which has since been acquired by the Science Museum, was printed in our issue of February 2, 1952. It was in the same issue that the article to which our correspondent refers appeared. The article was contributed by Mr. E. A. Forward.—ED., THE E.]

Conference on Engineering Education

THIS week a conference on engineering education is being held in London at the Institutions of Civil, of Mechanical and of Electrical Engineers. The conference, which opened on Monday, is the result of the meeting at the Hague in 1951, of the Europe and United States Engineering Conference, when it was agreed that improvements should be effected in the means of exchange of information on the education and training of professional engineers in the various countries. The object of this conference is to further the decision made at the last meeting of E.U.S.E.C. and promote a better understanding between the participating countries of the methods each adopt for professional engineering training and education. Delegates from societies in Belgium, Denmark, Finland, France, Germany, Holland, Italy, Norway, Sweden, Switzerland, United States, and from the three United Kingdom institutions are attending the conference. In addition to the working sessions which are being held in turn at the three institutions, the delegates will visit the Engineering Laboratories of Cambridge and the Imperial College and the technical colleges at Brighton and Rugby. While at Rugby the delegates will have the opportunity of studying typical practical training schemes for professional engineers.

COAL BURNING SPACE HEATING APPLIANCES.—A paper on " The Efficiency of Domestic Space Heating Appliances Using Solid Fuel " is to be presented to the Institute of Fuel by Mr. L. L. Fox on Tuesday, January 27th, at 5.30 p.m. The meeting will be held in the hall of the Institution of Mechanical Engineers, Storey's Gate, Westminster, S.W.1.

Shipbuilding and Marine Engineering in 1952

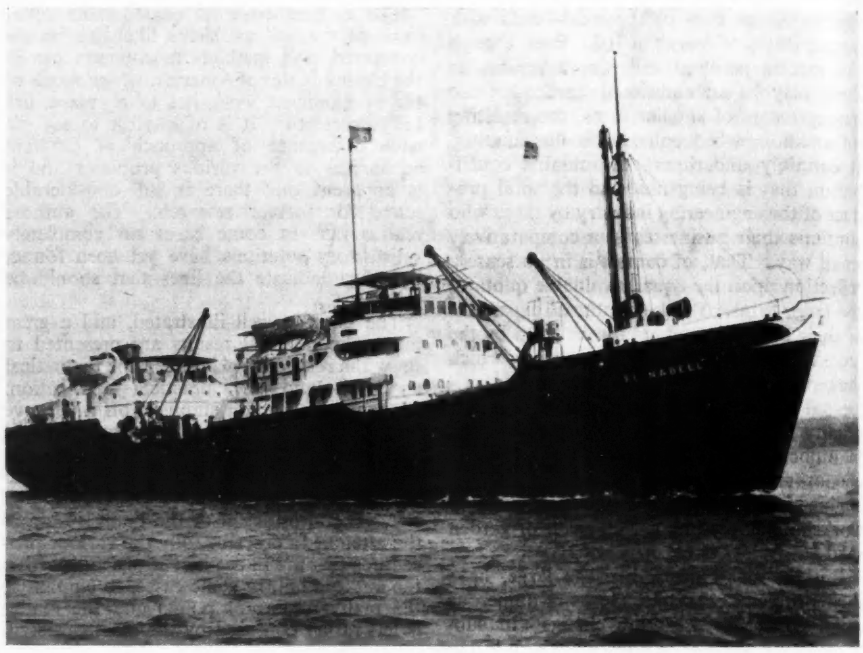
No. III—(*Continued from page 55, January 9th*)

LIGHT ALLOYS FOR SHIPBUILDING

INTEREST was steadily maintained in the use of the aluminium alloys during the year and the various problems, associated with the employment of the material for marine purposes, continued to form the basis of investigation from both the practical and technical points of view. As in previous years, non-stressed structures, such as small deck-houses, and small craft, such as lifeboats and yachts, continued to absorb the bulk of the metal used in the ship and boatbuilding yards. Methods of joining continued to be the main stumbling block in the development of larger structures, but progress was made towards the solution of large diameter riveting problems and the advances made in argon—arc welding technique has opened the way to the solution of the joining problem. With welding steadily superseding riveting in steel construction the lack of a corresponding welding method for the aluminium alloys placed them at a disadvantage. This will prove of a temporary nature when argon-arc welding is further developed and more equipment becomes available and also when more research has been carried out on the " Aircomatic " self-adjusting arc welding process which has been developed in America. Some welding was carried out by an " Aircomatic " set in the reconstruction of the superstructure of a Thames river launch, and this method, together with others, formed part of the investigations on the welding of light alloys under way in the laboratories of the British Welding Research Association. The manufacture of welding equipment using a shielded arc and a continuously fed bare wire electrode was commenced by the British Oxygen Company, Ltd., and the commercial production of sets under the name " Argonaut " is expected to begin this year.

The aluminium industry remains alert to the necessity of continued research and the research staffs of the various producer companies were fully engaged in efforts to solve both short and long-term problems. Last year the emphasis was on the casting side of the industry, and a Symposium on Aluminium Alloy Castings was held under the auspices of the Aluminium Development Association, when a series of nine papers, summarised in our issue of November 21, 1952, were presented.

The application of aluminium alloy to marine purposes was the subject of several papers read before the technical societies. Early in the year, Dr. E. C. B. Corlett read a paper before the North-East Coast Institution of Engineers and Shipbuilders, with the title " Aluminium as a Shipbuilding Material," which reported practical progress made up to date. Methods of joining and future trends were discussed and a code of practice was outlined, while tables giving the proposed scantlings for deck-houses and light superstructures were included. At the spring meetings of the Institution of Naval Architects, Mr. W. Muckle gave a paper entitled " The Scantlings of Long Deck-Houses Constructed of Aluminium Alloy," and considered the determination of the scantlings of long deck-houses, not contributing to the longitudinal strength, in terms of those given for steel houses by Lloyd's Rules. The problem of transverse stiffening of houses to resist static and dynamic forces was dealt with and a comparison made of the weights of steel and aluminium alloy construction. As already mentioned in the section dealing with technical papers, Mr. J. Venus and Dr. E. C. B. Corlett read a paper " Fire Protection in Passenger Ships : Some Implications of the 1948 Conference on Safety of Life at Sea, with particular reference to Aluminium Structures," during the autumn meetings of



Motor Vessel " El Nabeel "

the Institution of Naval Architects. The effect of the requirements on aluminium superstructures was considered and the results were given of various fire tests carried out using aluminium alloys in association with different insulating systems. Another paper was read by Mr. D. MacIntyre before the Society of Naval Architects and Marine Engineers in the United States under the title "Aluminium Ore Carriers." An economic and technical study was given of the light alloy bauxite ore carriers proposed for the Alcoa Steamship Company, and comparisons made between the principal characteristics, propelling machinery, scantlings, weights and costs of aluminium alloy and steel construction.

As already mentioned, aluminium alloy wheel-houses, navigating bridges, funnels and similar erections were fitted to a number of merchant ships, oil tankers, and trawlers, but no British ship was built in which the alloys were used for part of the stressed structure. However, a number of ships, built abroad, were commissioned during the year, including the "United States," built by Newport News Shipbuilding and Dry Dock Company, for the United States Lines, and to the requirements of the United States Navy. The Ateliers et Chantiers de France incorporated a considerable tonnage of aluminium alloy in the superstructure of the "Flandre," which the company completed to the order of the French Line. Another vessel in which extensive use was made of light alloys was the "Vera Cruz," a passenger and cargo liner of 18,000 tons gross, built by S. A. John Cockerell for Portuguese owners. All the above vessels will, no doubt, help towards proving the seaworthiness of the light alloys employed in their construction.

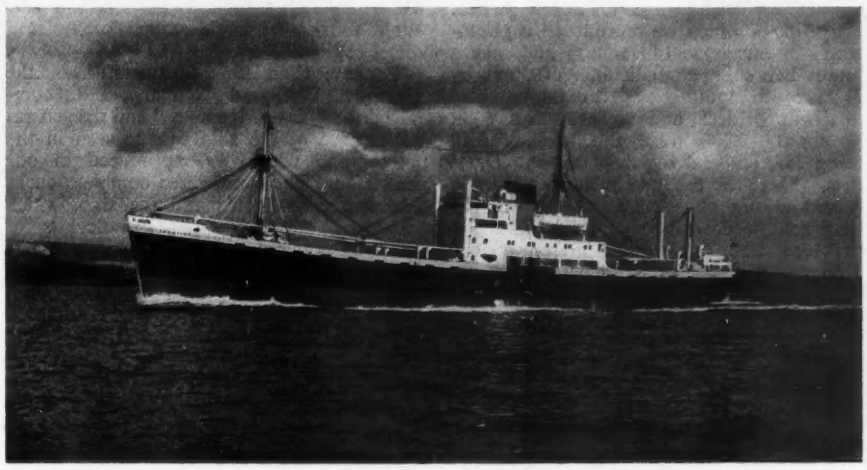
A considerable number of small craft were completely built of aluminium alloy, the material being extensively used for barge construction, and sixty barges, each of 60 tons capacity—described in THE ENGINEER of August 29th last—were built by Thorpe Brothers (Bessborough Works), Ltd., for work on the upper reaches of the Congo. Two ramped cargo lighters were built in aluminium alloy by Watercraft, Ltd., for the Royal Pakistan Navy and briefly described in our issue of May 23, 1952. Many shipping lines specified aluminium alloy lifeboats to be fitted on ships completing for them, and the Elder Dempster Lines took delivery of two ship-to-shore passenger tenders for service on the West African Coast, both of them 40ft launches built by Grimston Astor, Ltd. The same company built the 60ft motor yacht "Torquin," of which an account appeared in our issue of August 1st last year, and towards the end of the year Hugh McLean and Sons, Ltd., delivered the 40ft ocean-going auxiliary cutter "Coimbra," which was designed by Laurent Giles and Partners, Ltd., and described in THE ENGINEER of November 21, 1952.

LINERS

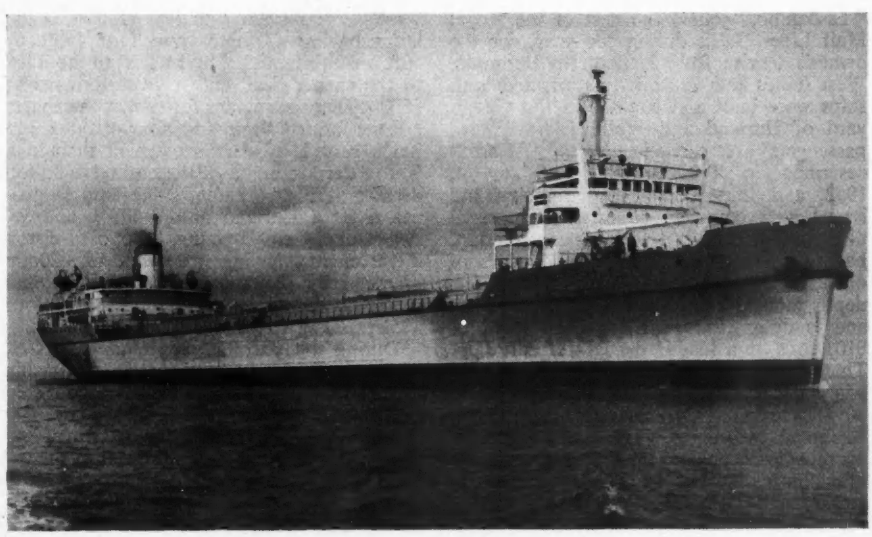
Last year two more one-class passenger liners joined the fleet of the Union Castle Steamship Company, Ltd., when the "Kenya Castle" sailed on her maiden voyage on March 31st on the round-Africa service of the company, and was joined later by the "Braemar Castle" on November 20th. Both vessels are sister ships to the "Rhodesia Castle," which was completed in 1951 and described in THE ENGINEER of December 7th of that year, and all were built at Belfast by Harland and Wolff, Ltd. The main particulars are: length between perpendiculars 540ft, breadth moulded 74ft, depth moulded 35ft 6in; gross tonnage 17,000 tons. Propulsion is by two sets of Parsons double-reduction geared turbines to give a service speed of 17·5 knots. Reference to the photograph of the "Braemar Castle," which appeared in our issue of January 2nd, shows a ship of pleasing appearance, having a raked stem, cruiser stern, well-rounded bridge front, low stream-lined funnel and two masts. The passengers, numbering 556, some twenty-six more than the "Kenya Castle," are accommodated in one, two, three and four-berth cabins, and all share the comfortably furnished public rooms, together with an air-conditioned dining saloon having a seating capacity of 288. Constructed by the shipbuilders, the triple expansion turbines develop a normal ahead power of 12,000 s.h.p. at about 100 r.p.m. of the propeller and take steam at 450 lb per square inch and 750 deg. Fah. from three Babcock and Wilcox boilers.

Barclay, Curle and Co., Ltd., built and engined the "Uganda" for the British India Steam Navigation Company, Ltd., and the ship joined the "Kenya," a product of the same shipyard, on August 2nd, when she sailed in the London to East Africa service of her owners. With a large, single funnel, painted in the familiar black with two white bands, contour plate stem, cruiser stern, two raked masts and a white-painted superstructure with a well radiused front, the ship, which we illustrated in our January 2nd issue, presents a well balanced profile. The liner has a length overall of 540ft by 71ft 6in breadth moulded by 38ft 6in depth moulded to "B" deck, and a gross tonnage of 14,500, while two sets of turbine machinery, constructed by the Wallsend Slipway and Engineering Company, Ltd., driving twin screws through single-reduction gearing, give the ship a speed of 16 knots. Accommodation for 191 first-class and 109 tourist-class passengers is provided and both classes have excellent public rooms and swimming pools and adequate space for deck games. Three Babcock and Wilcox oil-fired water-tube boilers, which operate under Howdens balanced system of forced draught and are associated with the Weir closed feed system, supply steam at 450 lb per square inch and a superheat of 750 deg. Fah. to the Parsons turbines, which develop a total normal ahead power of 11,200 s.h.p. at propeller revolutions of 125 r.p.m. Electrical power for the various services and auxiliary machinery is supplied by five 390kW diesel generators. A more detailed description of the ship and her machinery was printed in our issues of August 1 and 8, 1952.

In December last the "City of Port Elizabeth," which is the first of four passenger and cargo liners under construction, for Ellerman Lines, Ltd., at the Walker Naval Yard of Vickers-Armstrongs, Ltd., completed her trials and sailed recently

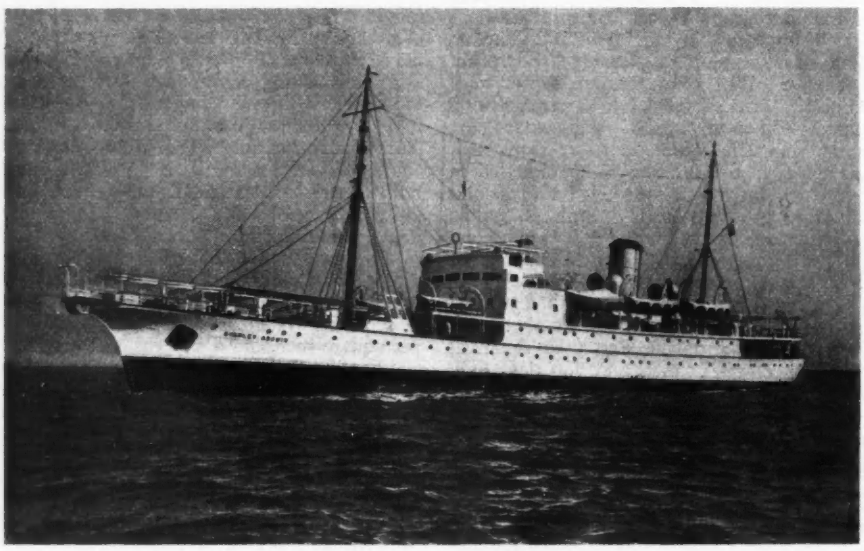


Motor Vessel "Trentino"



Steamship "Carl Schmedeman"

on her maiden voyage to South Africa. The ship, of which we reproduced a photograph in our issue of January 2nd, has a length between perpendiculars of 500ft by 71ft breadth moulded by 41ft depth moulded to the upper deck, and carries a deadweight of about 10,700 tons, the load draught being 28ft 6in and the displacement 19,645 tons. There are three complete decks and a curved raking plate stem, rounded cruiser stern combined with a well-balanced superstructure and a single funnel present a clean profile. A total of 106 passengers are carried in single and two-berth cabins, many of which have private bathrooms, and the spacious public rooms are all on the promenade deck. Propulsion is by means of two six-cylinder Hawthorn-Doxford oil engines, designed to burn heavy fuel of 3500 seconds, and capable of developing a total of 12,650 b.h.p. at 115 r.p.m., driving four-bladed solid manganese bronze propellers to give the ship a loaded service speed of 16½ knots. The electrical requirements for power and lighting are met by five 400kW, 220V d.c. diesel-driven generators.



Cable Ship "Stanley Angwin"

Cargo Liners

The motor cargo liners, "Ebro" and "Essequibo," joined the fleet of the Royal Mail Lines, Ltd., during the year, for the owner's service from London to Bermuda, West Indies and Central America, and both ships were built and engined at the Govan yard of Harland and Wolff, Ltd. Twelve passengers are carried and the "Ebro," described in THE ENGINEER of July 4, 1952, and illustrated in our January 2nd issue, is a complete superstructure vessel of mixed riveted and welded construction, having a length between perpendiculars of 415ft, a breadth moulded of 58ft 6in, a depth moulded to shelter deck of 38ft 4in, and is designed to carry a deadweight of 8101 tons on a loaded draught of 25ft 3½in. There are five cargo holds served by a full complement of derricks, including one of 30 tons capacity. A Harland and Wolff-B. and W. two-stroke, single-acting, opposed-piston diesel engine, having six cylinders of 620mm diameter by 1870mm combined stroke, and developing 4500 b.h.p. at 115 r.p.m., gives the ship a service speed of 14 knots, while the electrical power is provided by three 135kW generators, each driven at 450 r.p.m. by a six-cylinder Harland and Wolff four-cycle, single-acting, trunk-piston diesel engine.

For the Clan Line Steamers, Ltd., the Greenock Dockyard Company, Ltd., completed the "Clan Macinnes" and the general appearance of the ship can be seen in the photograph which we reproduced in our last issue. There are three complete decks and five cargo holds and the ship, which has a length between perpendiculars of 438ft by 60ft 6in breadth moulded by 37ft 9in depth moulded to the upper deck, was designed to carry a deadweight of about 9000 tons on a mean draught of 26ft. Electrical deck machinery is fitted and included in the cargo working arrangements are four 15-ton derricks, one to lift 30 tons and another of 60-tons capacity. In addition to the crew, twelve passengers are accommodated in two double and eight single-berth staterooms. John Brown and Co., Ltd., built and installed the main propelling machinery, which is a Doxford oil engine arranged to run on heavy oil, having six cylinders of 670mm diameter by 2320mm combined stroke, while the electrical load is met by three 180kW diesel-driven generators.

Among the ships delivered to the Elder Dempster Lines, Ltd., were the motor vessels "Onitoba" and "Obuasi," the latter having a length overall of 450ft by 62ft breadth moulded by 34ft depth moulded to the shelter deck and a gross tonnage of 5600. There are cabins for twelve passengers on the bridge deck and four main cargo holds served by derricks, which include a 50-ton derrick at No. 2 hatch and a 30-ton derrick at No. 4 hatch. The ship is propelled by a Harland and Wolff-B. and W. two-stroke, single-acting, opposed-piston diesel engine, having five cylinders, 620mm diameter by 1870mm combined stroke, and the main generating plant consists of four 125kW, 220V d.c. diesel-driven generators.

During the year Barclay, Curle and Co., Ltd. completed, for the Britain Steamship Company, Ltd., the motor-cargo ship "Windsor," which was launched by Her Royal Highness The Princess Royal on May 23, 1952. The ship, designed to carry a deadweight of about 9950 tons on a mean draught of 27ft, has a length between perpendiculars of 435ft, a breadth moulded of 58ft 6in, a depth moulded to shelter deck of 38ft, and embodies a number of special requirements of the owners, including all riveted construction. For strength purposes longitudinal framing has been introduced in the double bottom and the hatch coamings have been carried fore and aft, the spaces between the hatchways being plated over to form ballast tanks in order to improve stability in the ballast condition. Another item of particular interest is the ventilation system, only exhaust fans being fitted. The graceful appearance of the ship can be seen in the photograph which we reproduced in our last issue. A service speed of about 13 knots is maintained by a Doxford two-cycle oil engine, constructed by the shipbuilders, and arranged to burn heavy fuel. The engine, which has four cylinders 670mm diameter by 2320mm combined stroke, is fitted with a Bibby detuner flywheel and develops 4400 b.h.p. at 115 r.p.m.

Built by William Denny and Brothers, Ltd., for Ellerman Lines, Ltd., the "City of Winchester," shown in an illustration which appeared in last week's issue, achieved a speed of 18 knots on trial and carries a deadweight of 12,924 tons on a loaded draught of 29ft 8½in. The ship has the following particulars: length overall 567ft 9in, breadth moulded 71ft, depth moulded to shelter deck 45ft, gross tonnage 10,600 tons; three continuous decks and five main cargo holds. These are served by derricks for 20-ton, 10-ton and 7-ton lifts, operated by electric winches, and the electrical requirements of the various auxiliaries is supplied by two 300kW turbo-generators and two 300kW diesel generators. The vessel is propelled by a set of triple-expansion turbines, of Pametrada design, driving a "Scimitar" propeller of 20·5ft diameter by 16·4ft pitch, through double-reduction gearing. Steam for the turbines, which develop 13,000 s.h.p. continuously at 112½ r.p.m., is supplied by two Babcock and Wilcox single-pass boilers, designed for 450 lb per square inch pressure and 750 deg. Fah. at the superheater outlet and operating under Howden's forced draught and the Weir closed feed system.

The open shelter deck cargo ship "Flowergate," illustrated last week, was completed by the Burntisland Shipbuilding Company, Ltd., for the Turnbull Scott Shipping Company, Ltd. Designed for general trading, the ship carries a dead weight of 9450 tons on 25ft 9⅜in loaded draught and has the following dimensions: length overall 441ft 3in, breadth 56ft 8in, and depth moulded to shelter deck 38ft 3in. There are five holds and the forward main hold is served by a 25-ton derrick. John G. Kincaid and Co., Ltd., has supplied the main propelling machinery, which is a Harland-B. and W. two-cycle, single-acting diesel engine having four cylinders of 620mm diameter by 1870mm combined stroke and developing 3300 b.h.p. at 125 r.p.m. One multi-tubular and one vertical composite boiler are installed to supply steam for the various services and to the deck machinery.

For the Eastern Mediterranean trade of the Moss Hutchinson Line, Ltd., the Caledon Shipbuilding and Engineering Company, Ltd., built the motorship "Tabor," the leading dimensions of which are: length between perpendiculars 360ft, breadth moulded 55ft, depth moulded to shelter deck 32ft 6in, draught 21ft 9in, deadweight 5000 tons. Of open shelter deck design, the ship has five holds, which are served by thirteen derricks, including one of 25-tons capacity, and the weather deck has been kept clear for the stowage of railway coaches. The main engine is a Hawthorn-Doxford, four-cylinder, two-stroke oil engine, developing 4450 b.h.p., and the electrical power for

auxiliaries and deck machinery is supplied by three 175kW diesel-driven generators.

In the first half of the year Birt, Potter and Hughes, Ltd., took delivery of the general cargo carrier "Eaton," which was designed to carry 9900 tons deadweight at a service speed of 14 knots and has a length between perpendiculars of 432ft, by 58ft 9in beam, by 39ft 6in depth, and a deep load draught of 27ft 2in. All five holds have two 'tween decks above them and the hatches are equipped with 10-ton derricks with the addition of one of 30-tons capacity at No. 2 hatch. Propulsion is by means of a Barclay, Curle-Doxford oil engine, which has five cylinders of 670mm diameter by 2320mm combined stroke and was designed to give 5500 b.h.p. at 115 r.p.m.

Towards the end of the year Swan, Hunter and Wigham Richardson, Ltd., delivered the single-screw cargo motorship "Stylehurst," built to the order of the Grenehurst Shipping Company, Ltd. On a draught of 26ft 5in the ship carries a deadweight of 10,000 tons at a service speed of a little more than 13 knots. The ship, which has a length between perpendiculars of 435ft by 60ft breadth moulded by 39ft ½in depth to the shelter deck, is fitted to carry grain in bulk and the tank top is of increased thickness to take ore cargoes. Cargo is handled by 10-ton derricks and a derrick to lift 50 tons is arranged at the foremast and one of 20-tons capacity at the main mast; all are operated by steam winches. A four-cylinder Swan, Hunter-Doxford oil engine developing 4400 b.h.p. at 115 r.p.m. forms the main propelling unit and two cylindrical multitubular boilers provide the steam supply for the deck machinery, while two 35kW steam-driven generators meet electrical requirements.

Refrigerated Ships

To the fleet of the Blue Star Line, Ltd., the refrigerated cargo liner "Wellington Star" was added. It was built by John Brown and Co., Ltd., with a deadweight capacity of 14,000 tons and is propelled by two Brown-Doxford oil engines at a maximum speed of 18 knots. The length between perpendiculars is 535ft, the beam 72ft 6in, the depth 40ft 3in, and there is accommodation for twelve passengers. General cargo is carried in No. 1 and No. 7 holds, the shelter-deck space and the 'tween decks in No. 3 and No. 4 holds and included in the derricks serving the seven holds is one to lift 60 tons. Each main engine has six cylinders of 725mm diameter by 2250mm combined stroke, is fitted with a Bibby detuner, and develops about 7500 b.h.p. at 115 r.p.m. Four 330kW generators, each driven at 430 r.p.m. by a Ruston seven-cylinder, four-stroke diesel engine, supply the necessary electrical power for auxiliaries and the refrigerating machinery.

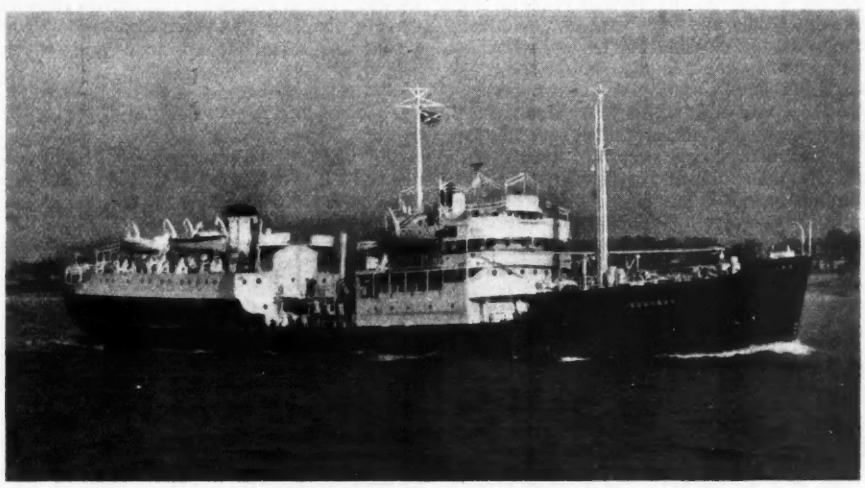
After the completion of sea trials in November last, Harland and Wolff, Ltd., handed over to the Shaw Savill and Albion Company, Ltd., the "Cedric," which has a length between perpendiculars of 481ft by 69ft breadth moulded by 41ft 6in depth moulded to the shelter deck and a gross tonnage of 10,800. There are six holds, of which Nos. 1 and 6 and the corresponding 'tween decks, together with Nos. 2, 3 and 4 'tween decks, are allocated for general cargo, the remaining holds and 'tween decks being insulated. The cargo handling equipment consists of one 50-ton, one 20-ton, four 12-ton, and other smaller capacity derricks, all operated by electric winches. Propulsion is by two single-acting, two-stroke, opposed-piston, Harland and Wolff diesel engines. In addition, the engine builders supplied four 320kW diesel-driven generators.

Built to the order of the Houlder Line, Ltd., the "Oswestry Grange" was completed as a closed shelter-deck ship by R. and W. Hawthorn Leslie and Co., Ltd., and handed over to her owners in April of last year. The ship, which we illustrated in our January 9th issue, has a length overall of 475ft, a breadth moulded of 61ft 6in, a depth moulded to the upper deck of 40ft, a service speed of about 12¾ knots, and four single-berth passenger cabins. Included in the complement of derricks serving the five hatches is one of 25-tons capacity and all are operated by electric winches mounted on raised platforms to provide clear space for deck cargoes. The main propelling machinery consists of a four-cylinder Hawthorn-Doxford oil engine, which develops 3780 b.h.p. in service at 100 r.p.m., while the necessary electrical power for the various services is supplied by three 200kW diesel-driven generators.

A photograph reproduced in last week's issue shows the refrigerated cargo liner "Surrey," which was completed in June last year by Alexander Stephen and Sons, Ltd., for the Federal Steam Navigation Company, Ltd. No passengers are carried and the ship was designed to carry 10,780 tons deadweight at a sea speed of 16 knots on a length of 469ft 6in by 64ft 6in beam by 42ft depth, with a load draught of 27ft 4in. The ship, which is largely of welded construction, is propelled by two nine-cylinder Sulzer two-stroke diesel engines driving a single shaft through the medium of a B.T.H. twin-pinion, single-reduction gearbox having a reduction ratio of 2·23 to 1, to give a propeller speed of 100 r.p.m. at full power. The engines each develop 4500 b.h.p. at 225 r.p.m. and are connected to their respective pinions through B.T.H. electromagnetic couplings. A description of the couplings and gearbox appeared in our issue of September 5, 1952

Cross-Channel Steamers and Short Sea Traders

For its cross-channel services British Railways took delivery of two ships, the "Normannia" for the Southampton/Havre run and the "Lord Warden" for the Dover/Boulogne service. Both ships were built and engined by William Denny and Brothers, Ltd. The "Normannia" made her maiden voyage on March 3rd and carries 1400 passengers on the following dimensions: length between perpendiculars 291ft, breadth moulded 48ft, depth moulded to upper deck 25ft 6in, gross tonnage 3543 tons. From the photograph, reproduced in Plate 2 in our issue of last week, it can be seen that the ship is of handsome appearance with a raked stem, cruiser stern, large funnel, two tripod masts, and well built up superstructures. There are two continuous decks and subdivision is provided by ten watertight bulkheads, while to limit rolling in heavy weather a Denny-Brown stabiliser is fitted. The interior of the ship creates a feeling of spaciousness, there are comfortable public rooms for both first and third-class passengers, a common dining-room and 325 sleeping berths have been provided in single two and three-berth cabins and lounges. The ship is propelled at 19·5 knots by two sets of turbines, of Pametrada design, driving the propellers at 270 r.p.m. through articulated double-reduction gearing. The turbines which are of all-impulse design, develop a total of 8000 s.h.p. and take steam supplied at 350 lb per square inch and 650 deg. Fah. by two Foster-Wheeler "D" pattern watertube boilers, operating on the closed stokehold system. A Weir closed feed system is incorporated and the electricity for all services is supplied by three 150kW Allen diesel-driven, 225V d.c., generators. A full description of the ship appeared in The Engineer of March 7th and 14th last year.



Royal Fleet Auxiliary "Eddybay"

Intended for carrying motor-cars to the Continent by the short sea routes, the "Lord Warden," can carry 120 cars, which can be driven direct on-board through folding steel doors at the stern. The ship, which was described in our issue June 27, 1952, has accommodation for 1000 passengers. The height of the car deck allows motor-coaches to be carried and there is space at the end of the promenade deck for some double-decker buses. Designed on modern lines, the ship has a curved raked stem, two tripod masts and a large, single funnel and a length overall of 361ft 6in by breadth moulded of 59ft by 17ft 9in depth to the main deck. Two sets of Pametrada designed turbines developing 8000 s.h.p., drive the ship at 20 knots and sufficient power is provided to give a speed of 16 knots for astern working. For the use of the passengers there is a smoke-room in the boat deck and on the promenade deck there are lounge buffets, lounge and a restaurant to seat 140 persons. Each set of turbines consists of a single all-impulse turbine, driving the propeller shafting through locked-train articulated

double-reduction gearing and the impulse astern turbines in the same casing can develop 85 per cent of the ahead power. Two Babcock and Wilcox integral furnace boilers, arranged fore and aft, supply steam at 350 lb per square inch and 650 deg. Fah. and work on the closed stokehold system, the air being supplied by two Allen forced draught fans. The Weir regenerative, two-flow main condensers work in conjunction with a Weir closed feed system and three 150kW Allen diesel-driven generators supply electric current at 225V d.c. for lighting and power.

Towards the end of the year Harland and Wolff, Ltd., handed over to Coast Lines, Ltd., the cross-channel motor vessel "Irish Coast," which will act as relief ship on the various night services between Great Britain and Ireland. The ship, which is illustrated in Plate 2 in our issue of January 9th, has a well-raked contour plate stem, two masts, a low, streamlined funnel and the following dimensions: length between perpendiculars 320ft, breadth moulded 51ft 6in, depth moulded 19ft and a gross tonnage of 3600. There are two complete steel decks, nine water-tight compartments and to minimise rolling Denny-Brown stabilisers have been fitted. Single and two-berth cabins accommodate 242 first-class passengers, who have at their disposal a lounge, smoke-room and a dining saloon seating eighty-two persons. For the third-class passengers there is sleeping accommodation for 146 in two and four berth rooms and large sleeping cabins. There is also a smoke-room and restaurant. The main propulsion machinery consists of two trunk-piston, two-cycle Harland-Burmeister and Wain diesel engines running at 155 r.p.m. and each having ten cylinders of 500mm diameter by 900mm stroke. Current is supplied the electrical installation by three 250kW, 225V d.c., diesel-driven generators supplied by the shipbuilders.

Among the ships delivered by The Grangemouth Dockyard Company, Ltd., was the single-screw motorship "El Nabeel," for the Halal Shipping Company, and the M.S. "Dryburgh," which is the 500th ship built at Grangemouth, for George Gibson and Co., Ltd., and James Rankin and Son, Ltd. The "El Nabeel," which we illustrate, has a length between perpendiculars of 260ft, a breadth moulded of 44tt, depth to shelter deck 22ft 3in, and carries a deadweight of 1680 tons on 14ft draught. Twelve single-berth cabins are provided for passengers, while provision has been made for carrying native pilgrims in the 'tween decks. The cargo handling arrangements are operated by four electric deck cranes. The ship, which attained a speed of 13·25 knots on trial, is propelled by a Kincaid-Harland and Wolff-B. and W. five-cylinder diesel engine developing 1550 b.h.p. at 160 r.p.m. and 1700 b.h.p. at 165 r.p.m. Three 75kW diesel-driven generators supply the electric current.

A number of new developments were incorporated in "Dryburgh," which carries a deadweight of 1380 tons on 14ft 6in draught and has the following dimensions: length overall 260ft, beam 38ft, depth to shelter deck 22ft 2in. There are three lower holds and one 'tween hold, which have MacGregor steel hatch covers and are served by derricks operated by MacTaggart Scott hydraulic winches. For working the hydraulic deck machinery there is a hydraulic unit, situated in the engine-room, consisting of three MacTaggart Scott multi-cylinder radial pumps, each driven by an 18 h.p., 1000 r.p.m. a.c. motor. The twelve passengers are accommodated in six two-berth cabins amidships with a lounge. Fluorescent lighting is installed and a point of interest is the cooking-range run on "Calor" gas. A British Polar two-stroke diesel engine having eight cylinders of 340mm diameter by 570mm stroke and developing 1520 b.h.p. at 300 r.p.m. gives the ship a loaded speed of 13·5 knots.

Two ships of identical dimensions but fitted with different machinery were completed by John Lewis and Sons, Ltd., for the Williamstown Shipping Company, Ltd. The ships have a length between perpendiculars of 250ft by 38ft breadth moulded by 22ft depth moulded to the quarter deck, and 17ft 9in to the upper deck, and carry a deadweight of about 2270 tons on a loaded draught of 16ft 11in. There are three holds, each served by a single hatch fitted with MacGregor steel hatch covers.

The first ship delivered, the "Cardigan Brook," has propelling machinery consisting of a triple-expansion engine having cylinders of 16½in by 28½in by 47in diameter by 30in stroke, which takes steam at 225 lb per square inch from two oil-fired Scotch boilers. For the "Cardiffbrook" there was fitted a Lewis-Doxford opposed-piston oil engine, which is the first engine of this design built by John Lewis and Sons, Ltd. The cylinders have a diameter of 440mm and a combined stroke of 1440mm and the engine, which weighs 85 tons, develops a service power of 1100 b.h.p. at 145 r.p.m. to give the ship a service speed of 11·5 knots.

Henry Robb, Ltd., handed over the single-screw motorship "Trentino," a photograph of which we reproduce, to Ellerman's Wilson Line, Ltd., upon completion of trials in the Firth of Forth, when a speed of 14·75 knots was obtained in the ballast condition. The ship, which has a length between perpendiculars of 290ft by 48ft 6in moulded breadth by 28ft 3in depth moulded to the shelter deck, carries a deadweight of 3000 tons on 19ft 6in mean draught at a service speed of 13 knots. The holds are served by four hatchways and the refrigerated hold is arranged in four compartments capable of carrying cargo down to 0 deg. Fah. The accommodation includes cabins for twelve passengers and there is a dining saloon to seat twenty-four persons, with a lounge on the deck over. Two eight-cylinder British Polar two-stroke diesel engines, each rated to develop 1520 b.h.p. at 300 r.p.m., propel the ship and drive a single propeller shaft at 145 r.p.m. through Vulcan hydraulic couplings and a Vulcan single-reduction twin-pinion, single-wheel gearbox and Michell thrust blocks. Auxiliary power is supplied by three 185kW diesel-driven British Polar generating sets.

(*To be continued*)

Coal in 1952

By SIR RICHARD REDMAYNE, K.C.B.

No. II—(*Concluded from page 73, January 9th*)

Profit per Ton—Prices and Export

THE profits or losses per ton, before charging interest, earned during the last quarter of 1951 and the first two-quarters of 1952 and average proceeds per ton were as follows:

	Average proceeds per ton		Profit or loss per ton	
	s.	d.	s.	d.
For the last quarter of 1951	52	1·9	Loss of 0	0·7
For the first quarter of 1952 ...	57	5·7	Profit 3	2·2
For the second quarter of 1952 ...	57	5·8	Profit 1	2·5

From this it will be seen that the loss during the last quarter of 1951 was only changed to a profit in 1952 by the increased price of coal, and even then out of the sixteen districts during the first quarter, only half were working at a profit and, during the second quarter, only six of them. The most profitable districts were Yorkshire, Derbyshire, Nottinghamshire, Leicestershire and North Stafford, namely, the districts which contain the best natural mining conditions.

We depend in large measure on the high prices we obtain for the coal we export for the profits earned by the coal industry, the demand for which has been and continues to be good.

A report on the European coal problem by the Economic Commission for Europe, which appeared late in February last, showed that European plans for expanding the output of coal in the next five years would not suffice to supply fuel and power for the increase of gross national products by 25 per cent, which means that Europe will still depend for some years to come on imported coal. But Britain must expect in the near future to meet increasing competition from Poland and Germany. If the contemplated 230 million tons production is realised we should be able to attain the desirable increase.

As Sir Hubert Houldsworth, Chairman of the N.C.B., speaking at Brackley, near Bolton, on September 6, 1952, said:—

"To-day the value of coal as an export commodity is greater than ever. As time goes on the export of coal is likely to be one of the most vital factors in our economy. Although there are encouraging signs there should not be the slightest feeling of complacency in the industry."

On June 22nd last it was stated in the Press that the Government had decided to increase by another million tons our coal exports this year, so bringing the total up to 12,500,000 tons, compared with 7,950,000 tons exported in 1951. According to Mr. Geoffrey Lloyd: "In March, the Government announced their decision to increase coal exports this year by 2,000,000 tons, as compared with 1951, and last week I announced a further increase of 1,500,000 tons. The bulk of this extra coal has already been sold abroad. At present prices these coal exports should earn some £60,000,000 of foreign exchange as compared with coal earnings of just under £30,000,000 last year.

"Most of our coal is going to Europe and, on the basis of our current position in the European Payments Union, we estimate that our coal exports to European countries will reduce our payments in gold to the Union by an amount at present equal to the full value of the coal."

Consumption

The N.C.B. stated on April 29th that as a result of the higher production and the milder weather as well as satisfactory transport, stocks of coal were then about 13,000,000 tons as compared with 9,500,000 tons at about the same time in the previous year. Coal stocks had by September reached such a high level as perhaps to render derationing possible, and industrial consumers would start the winter with larger reserves than for any year since the war, and this despite the increase in exported coal, the reserves amounting to 17·5 million tons as compared

with 13·8 million tons in 1951. Coal merchants had 1,349,000 tons of household coal as compared with 8,780,000 in 1951, stocks of boiler fuel and anthracite being double at 156,000 tons.

On October 28th, the Minister of Fuel and Power announced in the House of Commons, when opening a debate on the mining industry, that we had a stock of over 19,000,000 tons of coal, "the largest since the war."

Turning to the subject of actual consumption of coal, the biggest single consumer of coal in the country is the British Electricity Authority, which had six and three-quarter weeks' supply in reserve as against five and a half weeks' supply at the same time in the previous year. But as both electricity and gas undertakings had increased their productive capacity this will entail a larger consumption of coal in the future.

The advisability of the inauguration of a national fuel policy was a subject which received much notice in the Press during the past year. Mention may be made of the report of the Ridley Committee, which was appointed by the Labour Government in July, 1950, to consider what steps should be taken to promote the best use of our fuel and power resources. This report, which was issued on September 10th, was the work of a committee consisting of Lord Ridley and seven other members. It produced an estimate of what our demands were likely to be for home and export in the near future, which was 20,000,000 tons higher than the Coal Board thought it would sell—so the Minister stated in the House of Commons on October 28th. The report proposed that there should be set up a joint planning board on which, with the assistance of the Minister, the fuel industry of the country could concert policy. It also recommended that the Minister of Fuel and Power should be helped in the general control of fuel pricing policy by an expert tariffs advisory committee.

As *The Times*, commenting on the report in a leading article in its issue of September 11th, wisely says, the report "concludes sensibly that proper relation between the various fuel and power services—oil, coal, coke, electricity and gas—will best be achieved by maintaining competition within an appropriate framework. The committee wishes to see the end of all forms of rationing as soon as possible; consumers should be left with freedom of choice, but their choice should be guided by bringing prices closely into accord with relevant costs." Hence, the desirability of a tariff advisory committee. The railways are advised, in the report, to accelerate trials of new means of traction for the replacement of the steam locomotive which wastes nine-tenths of the heat afforded by the coal they burn. In connection with this recommendation of the Ridley Committee, attention may be directed to the extent of the saving in coal which would be secured by the more extensive electrification of our railways. According to the 1931 committee on main line railway electrification, 9,750,000 tons of coal could be saved per annum by the electrification of our main line railways.

With regard to the question of coal prices, one cannot do better than reproduce some of the comments of *The Times* in the aforementioned leading article, as they go to the heart of the matter:

"Although the committee seems united in favour of charging marginal cost prices for peak load electricity, if it can be done, it is divided about the application of this principle to coal; the economists and academic members are in favour, the business men against. Among the arguments against raising coal prices 'to the margin' is the familiar one that a rise in coal prices will raise the costs of export goods and the cost of living, and so set off the inflationary spiral—an argument which would prevent any major change of relative prices. Fear that miners would ask for higher wages (which they seem to do in any case) has led to the proposal that any increase of price on grounds of fuel policy should be offset by levying an Excise duty, so that the Coal Board gets no higher profits. These differences over coal prices show the difficulty of the task which would face the tariffs advisory committee. Indeed, it seems desirable that some agreement on the point of principle on which the Ridley Committee was divided should be reached before such a committee sets to work.

The recommendation that such a body should be appointed is valuable, provided that its members include some who could bring to its discussions an understanding of the broader issues."

When one takes a comprehensive view of the subject one fact stands out as inevitable—consumption of coal in our country is increasing at a greater rate than its production. Taking electrical generation alone, as Mr. Gerald Nabarro, M.P., has pointed out in *The Times* of March 13th last, the British Electricity Authority at present consumes at the rate of 35,000,000 tons of coal per annum, but if its investment programme is carried into effect the consumption by 1965 will be increased by 30,000,000 tons.

The area gas boards have developments in view which, when effected, will also result in substantially enhanced coal consumption. The Coal Board's estimate of the probable demand for coal in 1965 was only 7,000,000 tons more than was actually used in 1951, yet the house demand alone is rising at something like 3,000,000 tons a year.

Last February 24th a report by the United Nations Economic Commission for Europe, the work of the Commissions' Research and Planning Division, was published in which it was stated that the British open fireplace was the most notorious example of fuel wasting, adding that wasteful use of coal and of electric power in British homes was helping to cut the amount of coal available for export to the Continent. It stated that between three-quarters and nine-tenths of the heat is lost up the chimney of an open fireplace or remains as unburnt coal in the ash.

It is to be hoped that the subject of the better and more economical use of coal and of fuel in general will receive the earnest attention of the Government and public, and means be found for putting into practice a national fuel policy.

Manpower and Miners' Earnings: Absenteeism

By April 19th the total manpower on the colliery books had reached 713,000, the highest since September, 1949.

Sir Hubert Houldsworth, the chairman of the N.C.B., mentioned in his speech in London on May 19th last that the total manpower was 716,000 by May 16th last, but that at least 725,000 to 730,000 would be required, if the bad age distribution of the miners was to be corrected. Younger men were entering the industry, but there was high wastage in the twenty-one to thirty age group, and the advantages of additional labour could not be realised until the recruits were trained and coalface room prepared for the larger number of workers. Mr. Geoffrey Lloyd, the Minister of Fuel and Power, speaking in the House of Commons on July 7th last, stated that manpower had increased by 23,000 over the preceding twelve months, which is very heartening.

The miners' average earnings per man-shift for the last quarter of 1951 and the first two-quarters of 1952 were as follows:—

	At the face	All underground	Surface	All workers
	s. d.	s. d.	s. d.	s. d.
Fourth quarter, 1951	—	... 44 9·2	... 30 3·6	... 41 3·4
First quarter, 1952	53 4·1	... 46 3·9	... 31 4·6	... 42 9·0
Second quarter,	53 0·2	... 45 9·8	... 31 2·3	... 42 3·4
1952	53 0·2	... 45 9·8	... 31 2·3	... 42 3·4

The average earnings in industry in April last, published in the issue in September last of the *Ministry of Labour Gazette*, showed that all other industrial workers had fallen far behind the miners. Figures provided by the N.C.B. showed that adult miners averaged 233s. 3d. per week ended April 26th, exclusive of the value of allowances in kind, estimated to average 10s. 6d. The average earnings of men in the industries for which the Ministry collects statistics was 173s. 7d. The complete statistics about abstention from work during 1952 will not be available for some time yet, but judging from published data absenteeism continues to be nearly double that for the year 1938.

In June last, the mineworkers' union made a claim for an increase of £1 10s. a week in the pay of all adult male miners, owing to the increase in the cost of living since December; but on July 22nd the National Coal Board rejected this claim. It will be remembered that the miners' last increase dated from November 22, 1951, when the minimum rates for all underground workers were raised by 13s. 6d. to £7 0s. 6d. and for surface workers by 11s. 6d. to £6 1s. 6d.

The miners' claim was rejected by the national reference tribunal for the coal industry to which it had been referred, and at a meeting in London on November 7th the decision was accepted by the miners' delegates. It has been estimated that if the claim had been conceded it would have added £50,000,000 a year to the N.C.B.'s wages bill.

It was announced at the meeting of the miners' delegates that the N.C.B. had agreed to adjust the system of payment of a bonus shift under the five-day week agreement so that in future men who lose work through accident, bereavement or local government work will be paid a proportion of the bonus shift; hitherto it had only been paid to miners who had worked the full shifts in the week. The delegates instructed their National Executive Committee to open negotiations with the N.C.B. to obtain some increase—no amount being specified—in the wages of the 400,000 datal workers. But so far their application has not been acceded to. It will be remembered that late in 1951 datal workers received a considerable advance in their wages.

The leaders of the National Union of Mineworkers, early in the year, recommended an extension of the agreement which provided for Saturday working except in the summer months. A strike at a number of collieries in Yorkshire took place in the past summer by the overmen, deputies and shotfirers against the N.C.B.'s alleged failure to offer a reasonable wage increase.

It is interesting to learn that during 1951 there were 1637 disputes, in none of which were the workers supported by the Union.

Health and Safety

The annual report of the Chief Inspector of Mines is not issued to the public until late in the following year, and that for 1951 has not appeared at the time of writing this article, so that, in commenting on the statistics as to health and safety in regard

to the 1663 mines at work under the Coal Mines Act, 1911—of which 1404 are coal-producing mines, one has to have in mind the statistics embodied in the report for 1950, which was published on February 7th last. Comparing 1950 with 1949, the figures of persons killed and of those seriously injured were as follows :—

	1950		1949	
	Killed	Injured	Killed	Injured
Underground :				
For falls of ground	186	716	238	792
For haulage	92	517	109	483
For explosions	97	41	9	42
For shafts	16	25	13	20
For miscellaneous	56	519	42	622
On the surface	46	202	49	221
Total	493	2,020	460	2,180

In the report the Chief Inspector describes fires at underground conveyors as being the most serious hazard in mining to-day and mentions that this class of accident reached the record number of eighteen in the year 1950.

The number of serious non-fatal accidents which had fallen to 2020, was the lowest on record.

One had hoped that the era of great explosions in coal mines had passed with the putting into force of preventative measures resulting from the knowledge gained about the part played by coal dust in these disasters, but, alas, a new element of danger has arisen, as exemplified in the explosion at Easington Colliery, County Durham, which occurred on May 28, 1951. The interesting and valuable report by the Chief Inspector of Mines was published in September last. He states that : " The initial cause of the explosion was an ignition of firedamp on the third South Longwall face, caused by friction of coal cutter picks on pyrites," and that " the main issue of firedamp was from an accumulation in large cavities in the waste behind the longwall face," and that it " was forced out during a roof weight," the firedamp accumulating because cavities were left when the roof failed to cave satisfactorily. Coal dust mainly derived from the conveyor belt and structures in the vicinity, carried on the explosion. The explosion spread through 16,000 yards of roadway, causing the death of eighty-one persons. Two others lost their lives in the rescue operations.

The Chief Inspector's remarks on the subject of danger from sparking are of much interest. He says : " It has, of course, been known for many years that firedamp could be ignited by the action of coal cutter picks on pyrites and on certain types of rock or inclusions containing quartz. I have purposely avoided using the word ' sparks,' because with pyrites at least it would seem that ignition is not caused by sparks themselves, so much as by finely powdered pyrites dust, which is heated by friction until it bursts into flame. The distinction in the mechanism of ignition is important because it accounts for the fact that blunt picks are more likely to cause ignition than sharp ones."

Acting upon a recommendation of the Safety in Mines Research (Advisory) Board, a Working Party consisting of members of the Ministry of Fuel and Power and of the National Coal Board, has been formed to investigate the problem of firedamp ignition by frictional sparking, with particular reference to coal-cutters and stowing machines ; and to advise as expeditiously as possible as to the steps which might be taken to remove or control the risk.

This admirable report on the explosion by the Chief Inspector should have the careful study of all interested in coal mining, whether at home or abroad.

In view of the fact that the extraction of coal will in the future be from increasingly deeper and consequently hotter mines, the action of the National Coal Board, as announced in the Press of November 9th last, in making a grant of £1500 a year for three years, to the University of Oxford for research work into hot and humid conditions is to be welcomed. The research work is being carried out in the Department of Human Anatomy, and the Coal Board's technical and medical staffs will co-operate in the research.

Mechanisation

Just over 80 per cent of the coal output is mechanically cut and 85 per cent is mechanically conveyed, so it would almost appear as if saturation point has been reached in so far as coal-cutting by machines and mechanical face-conveying are concerned. For, at some mines, the physical condition in respect of the coal seams precludes the application of coal-cutting machines, e.g., where the coal will not stand up for the process of mechanical cutting or, owing to the nature of the roof, necessitating the installation of supports so close to the face as to leave no room for the traverse of the machine. The kind of mechanisation at the face, for which there is probably still room for expansion, is in respect of the mechanical loading of coal, and in the mechanical stowing of the waste. With regard to the latter possibility, the filling in of the goaf or waste by the hydraulic method and, more recently, by pneumatic power, has been long known and practised, though much more extensively on the Continent than in the United Kingdom owing to the conditions being more favourable to their application on the Continent. But recently attention has been directed towards devising machines which shall perform the work of filling the waste, such as, for instance, the scraper stower. The scraper conveyor travels at the rate of about 200ft per minute, conveying and packing the material into the waste. At such a moderate rate of travel there should not be much risk of sparking. That point, however, we may feel sure will not be lost sight of by the research working party already referred to.

Nationalisation

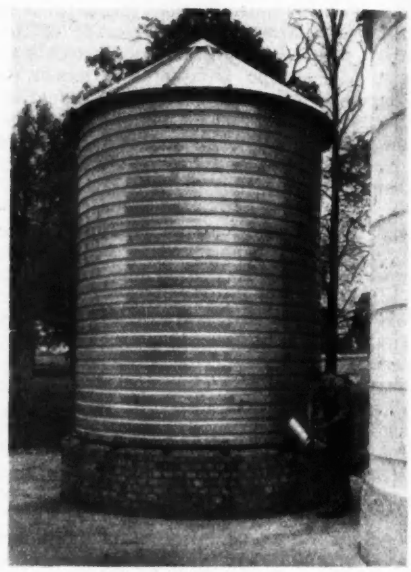
Reference was made in the article " Coal in 1951," which appeared in THE ENGINEER during January, 1952, to an essay on Consumers Councils, in respect of the coal industry ; the same author, Mr. A. M. de Neuman, has recently written an extensive review of " The Economic Aspects of Nationalisation in Great Britain," a thoughtful and valuable contribution to this very important subject. His references to the bearing on nationalisation of the coal industry will be of particular interest to those concerned with that great industry, as of industry in general, and to our politicians and economists, for, as the Earl of Halsbury said, speaking in the House of Lords on June 11th last, " was there ever a country so dependent on fuel for its life-blood as this country."

LIGHT ALLOY BODIES.—Part I, of a publication entitled " Materials and General Practice, " in a new series called "Light Alloy Bodies for Road Haulage Vehicles," has been published by the Northern Aluminium Company, Ltd. The physical properties of the recommended extrusion and casting alloys are tabulated and some notes on their other properties are given. Suitable sections are suggested, together with illustrations, for the underframe, cross-bearers, flooring, side raves, panel stiffeners, framing and roof sweeps and technical information is given concerning sheet material. A few representative moulding sections are illustrated and there are notes on working with aluminium, including sections dealing with forming, cutting, riveting, welding and finishing.

An Aluminium Grain Silo

THE use of the combine-harvester raises grain storage problems which do not affect the farmer who uses a binder and so can keep his crop in rick and thresh as required. With the increasing use of combine-harvesters a glut of grain is created which cannot be taken up by buyers, so that the farmer has perforce to store the grain until required. This problem is becoming more acute and, aware of the difficulty of storing in sacks, the Ministry of Agriculture and Fisheries initiated the development of a silo of 20 tons capacity which would be hygienic, weatherproof, vermin-proof, inexpensive, durable, easily erected and built of material readily available.

One of the prototype silos, which is undergoing field trials at the National Institute of Agricultural Engineering at Silsoe, Bedfordshire, is of all-aluminium construction. It is light and strong, impregnable to vermin and will not corrode so that internal hygienic qualities are unaffected and the material being smooth



An Aluminium Grain Silo

and impermeable will not harbour insects or bacteria or promote mould growths liable to damage or contaminate the grain. Painting or other surface protection is unnecessary, so that maintenance costs should be very slight. The photograph reproduced herewith illustrates a silo which was erected by the Northern Aluminium Company, Ltd., of Banbury, Oxfordshire, and designed with the minimum number of components to facilitate production, to keep costs as low as possible, and to simplify erection. The silo, of 20 tons capacity, is 10ft in diameter by 16ft in height and has a weight of 3 cwt, which enables it to be erected by three men with the aid of scaffolding or lifting gear.

A special form of corrugated sheet, known as Mansard sheet, forms the wall, there being four sheets bolted together to make one complete ring, of which five are required for the 20 ton silo, other capacities being provided by adjusting the number of rings used. Sixteen triangular panels with overlapping flanges, to exclude rain, form the roof. This is assembled on the ground, mounted on the first ring, which is then raised on four supports to permit the next ring to be attached and the process is then repeated for each tier. For ease of assembly bolted joints have been adopted, for which standard size bolts are used for the joints. A door in the roof gives access to an aluminium ladder fitted for internal inspection purposes. The structure, which has an outlet chute at the bottom for the discharge of grain into sacks, is mounted on a brick and concrete plinth 3ft in height. It is estimated by the Ministry that the current requirements are for about 8000 silos.

Metallurgical Developments in 1952

(*Contributed*)

A MAJOR effort has been directed during 1952 to the conservation of metals which, during 1951, were scarce and of which a still more serious shortage was expected to arise. As a result of much research and planning, the committee appointed in 1951 to review the metal supply position were able to report in November, 1952, that although no metal was plentiful and some restriction on demand must be maintained, the acute shortages had eased and supplies were at the time sufficient to meet essential needs.

Conservation of Alloy Steels

One of the more important economy measures which continued to receive attention was the conservation of alloy elements in steel. A Direction, which became effective in June, was issued by the Ministry of Supply restricting the use of molybdenum and nickel in certain kinds of alloy steel. Necessary action in this and in other economy measures affecting alloy steels has been greatly facilitated by the efforts of the Alloy Steel (Rearmament) Technical Committee, who have made recommendations concerning steels to En Specifications which are most suitable for use in complying with the Direction. Their work will be a permanent contribution to economic efficiency. For many purposes effective reduction of molybdenum is not possible. Only a small saving could be brought about by change of composition of the creep-resisting carbon-molybdenum steel used in power stations, but it is expected that consumption of this steel will tend to decline owing to changes in power station design. Restrictions on molybdenum have directed attention to the possibility of its replacement by vanadium, and to the development of local sources of vanadium supply. Vanadium added to high-speed tool steels permits a considerable reduction in tungsten content. Although nickel steels have to some extent been replaced by chromium steels, the actual output of, for example, chromium-nickel austenitic stainless steels has shown an increase during the year. Nickel economies have been made mainly in non-ferrous materials.

The use of boron in steel is rapidly increasing and the advantages and limitations of boron steels have been widely discussed. Whereas in America boron is used exclusively in heat-treated steels and hardenability is the criterion by which the effect of boron is judged, in this country it has also been used to improve the properties of as-rolled and normalised steels (for example, the United Steel Company's " Fortiweld "), and attention has been directed to methods of adding controlled amounts of boron in the correct mode of occurrence. Claims have been put forward in America for the advantages of the addition of the rare earth elements to improve the hot workability of stainless steels, to increase the resistance to oxidation of high-chromium alloys, and to improve the ductility and toughness of heat-treated nickel-chromium-molybdenum steel, but the use of such additions still awaits commercial development.

High-Temperature Steels and Alloys

Particulars of Nimonic 95, the latest addition to the Nimonic series of alloys, have been released during 1952. This is a modification of Nimonic 90, giving superior creep properties at higher temperatures. Acceptance creep tests are carried out for this alloy at 870 deg. Cent. with a load of 9 tons per square inch and a minimum life to rupture of 100 hours. This is a considerable improvement over Nimonic 90, which has a minimum life to rupture of seventy-five hours under a load of 7 tons per square inch.

An economy alloy containing about 34 per cent of nickel and 21 per cent of chromium (balance iron), developed in America under the name of Incoloy, is similar to Nimonic D. A modification of this, known as Nimonic DS, contains nickel 37, chromium 18 and silicon 2 per cent. Though less resistant to oxidation than the alloys of higher nickel content, it is a useful heat-resisting material for furnace parts in oxidising conditions up to 950 deg. Cent., and in reducing conditions to even higher temperatures. Work is in hand on a stronger alloy of the same basic composition, Nimonic DT, for service as a material both for flame tubes and also for turbine blading operating at temperatures within the range 500 deg. to 700 deg. Cent. For the joining of Nimonic and other high-temperature materials, brazing alloys containing palladium are being developed. These brazing alloys combine good mechanical properties at elevated temperatures with a high resistance to oxidation.

Increased use has been made of less highly alloyed materials. For turbine discs in newly designed engines, ferritic steels, such as 3 per cent Cr-Mo-V-W and 10/12 per cent Cr-Mo-V-Nb, are now almost exclusively employed, although warm-worked G 18B discs are still being produced for the older engines, such as the " Nene " and " Derwent V," and for the high-temperature first and second stages of some fairly new multi-stage engines, such as the " Proteus." There has been continuous investigation of the influence of additional elements on nickel-chromium austenitic heat-resisting steels with a view to increasing their resistance to thermal shock and to corrosive attack and decreasing their susceptibility to sigma embrittlement. To take one example, throughout the past year the research effort of Messrs. William Jessop and Sons has been directed largely to the development of new nozzle guide vane and turbine blade alloys. Towards this end a great deal of emphasis has been placed on thermal shock testing for nozzle guide vane materials. There is as yet no standard form of thermal shock test, so the company has constructed its own testing rig based on a Metropolitan-Vickers scheme. The rig is designed to impose alternate heating and cooling on wedge-shaped specimens. The full heating and cooling cycle takes two minutes and the number of cycles before cracking is taken as a measure of thermal shock resistance. This test has provided a new criterion for the assessment of good nozzle guide vane materials. Numerous patent specifications, filed during the year by Sheffield steelmakers and by jet engine builders, indicate active research on balanced compositions to give optimum precipitation hardening or response to warm working in complex austenitic steels. All the principal steelmakers are introducing modifications or improvements, but there is necessarily a lag in the publication of the preferred compositions and treatment. Among the new alloys put forward during the past year, the three following represent the outcome of the Jessop research programme : —G 35, with a minimum of strategic elements, for service at temperatures up to 900 deg. Cent., particularly suitable for precision cast nozzle guide vanes ; G 39, a precision-casting nickel-base alloy containing nickel 60, chromium 20, iron 10 per cent, with carbide-forming additions, of high creep strength and excellent thermal shock resistance, designed primarily for nozzle guide vanes operating at temperatures of the order of 950 deg. Cent., and G 42, a wrought turbine blade alloy with a minimum of strategic elements, but containing 25 per cent of cobalt, of improved creep strength and particularly useful in the temperature range 850 deg. to 950 deg. Cent.

Ceramic coatings are reported to be substantially increasing the service life of high temperature alloys, particularly in the exhaust system of aircraft. In America, the most successful and widely used is a high-barium, alkali-free frit, having a 30 per cent admixture of chromium oxide (A 417) developed by the U.S. National Bureau of Standards. Advance has been made in the production of titanium carbide alloys. The use of these materials in gas turbines has, however, not yet passed beyond the experimental or development stage, though there are prospects of their finding standard applications. In less severe conditions there is extensive use of ceramics and also of chromising, for suppressing oxidation and for increasing the heat-resistance of low-alloy steels.

Spheroidal-Graphite Cast Iron

There has been a continuous increase in the range of applications of nodular or spheroidal-graphite cast iron, now widely referred to as " S.G. iron." Many new applications are recorded in the publications of the Mond Nickel Company S.G. iron has proved to be more suitable for hot-tinning and hot-dip galvanising than ordinary cast iron, and its high-temperature properties are also superior. Production of a uniformly satisfactory product is not without difficulties, some of which have been overcome during 1952. The introduction of magnesium by means of a nickel-magnesium alloy, besides being uneconomical of nickel, has sometimes proved to be a disadvantage, as nickel tends to stabilise pearlite and retard ferrite formation during annealing, thus increasing the strength and hardness, but decreasing the ductility of the product. Safe and effective methods of treatment with metallic magnesium or Elektron scrap have been evolved. The magnesium process will give spheroidal-graphite structures even in heavy sections, but certain elements, likely to be present in British pig irons, interfere with the effect and cause a progressive increase in flake graphite with increase in section. Even very small quantities of titanium, lead, antimony and bismuth may prevent the formation of spheroidal graphite ; so also will larger amounts of aluminium. The British Cast Iron Research Association found that a residual cerium content of 0·005 per cent was usually ample to neutralise the harmful effect of these and other elements. By adding 0·01 per cent of Mischmetall after the magnesium, it was possible to use raw materials which had previously been considered unsuitable. The magnesium treatment can be applied to pearlitic, martensitic or austenitic cast irons. S.G.Ni-Resist has the excellent resistance to corrosion already associated with Ni-Resist, together with enhanced resistance to high-temperature conditions, and is in use for many special castings, including parts of aircraft jet engines. " NOduMag," the S.G. variant of the nickel-

manganese iron " Nomag," is now in production by Ferranti, Ltd.

Non-Ferrous Metal and Alloys

For steam condenser tubes in power stations, 70 : 30 copper-nickel has, when possible, been replaced by aluminium brass, but if this is unsuitable, owing to the degree of contamination of the water, 90 : 10 copper-nickel with 1·5 per cent of iron has been used. Trials have also been made with an alpha bronze containing 12 per cent of tin. The supply of nickel anodes for plating baths has been severely restricted and various substitutes have been investigated, e.g. bright zinc, tin-zinc, tin-bronze, &c., with promising results. Chromium-plating on copper has satisfactory qualities in some respects, but lacks the corrosion resistance of chromium on nickel. It seems possible that a continued shortage of nickel may seriously affect the efficiency and quality of high-grade plating work. In furthering both these economy measures, the B.N.F.M.R.A. has played an important part.

At the Swansea Laboratories of B.I.S.R.A., progress has been made, in a pilot plant, in the production of an aluminium coating on steel in place of the zinc coating produced by hot galvanising. Many initial difficulties have been overcome, one of the more important being the correct preparation of the steel surface before dipping. With the same object in view, namely, to replace zinc as a protective coating against rust and corrosion, the General Motors Research Laboratories, Detroit, Michigan, have announced the development of a process called " Aldip," in which the prepared steel surface is dipped for about four minutes in a preheating salt bath at 700 deg. to 750 deg. Cent., then transferred to an aluminium bath covered with a layer of flux for one-half to one minute with a subsequent treatment to ensure uniformity of the coating. It now appears that zinc may not be so scarce as was at one time feared. In fact, the supply is now expected to be adequate to meet the growth in demand with little or no increase in real zinc costs. A rise in price would, however, encourage greater substitution of other metals for zinc not only in galvanising but also in the production of die castings.

An improved aluminium alloy has been produced by the addition of a small quantity of cadmium to 95 : 5 aluminium-copper. The cadmium addition delays age hardening at room temperature after solution treatment, but accelerates and increases the amount of hardening which takes place at slightly elevated temperatures. The aluminium-copper-cadmium alloy in the fully heat-treated condition has properties at least equal to those of the normal Duralumin type, but shows a remarkable facility for hot working by forging or extrusion and does not age at room temperature after solution treatment. The alloy may therefore be fabricated more cheaply and at a greater rate than the conventional Duralumin type. It is not necessary to carry out cold working operations such as bending and dressing immediately after solution treatment, or to refrigerate the alloy, as is necessary in the case of Duralumin, to avoid room-temperature hardening. The work on which this development is based was carried out at the Fulmer Research Institute, which, in 1952, celebrated the fifth anniversary of its foundation. Other work published by this Institute during 1952 related to the production of aluminium of high purity by catalytic distillation, and to the development of low emissivity coatings for the combustion chambers of gas turbines.

Work on the improvement of the creep properties of magnesium alloys has continued. The zirconium alloys had already marked an improvement, followed by the introduction of 3 per cent of Mischmetall, giving alloys of outstanding creep resistance at 250 deg. Cent., combined with excellent casting properties. The latest development, announced by Magnesium Elektron, Ltd., is an alloy containing 2·5 per cent of zinc, 0·7 per cent of zirconium and 3 per cent of thorium. This alloy (known as ZT 1) has a creep rate at 350 deg. Cent. of the same order as that of the cerium alloy at 250 deg. Cent. under a load of 0·5 ton per square inch. At 315 deg. Cent. under a load of 1·5 tons per square inch its creep rate is only about one-eighth that of the cerium alloy at half the load.

Welding

The opening, in June last, of the new Fatigue Testing Laboratory of the British Welding Research Association at Abington Hall, Cambridge, gave a substantial increase in the space available for the Association's researches. An important part of the work is the investigation of high strength weldable structural steels. They were chiefly low-alloy nickel-chromium-molybdenum steels, but encouraging results were obtained from a series of steels of similar composition in which molybdenum was replaced by vanadium. The over-riding effect of small variations in carbon content was established. Work has been published on the load-carrying capacity of frame structures ; a survey has been made, in co-operation with Babcock and Wilcox, Ltd., of the stresses in welded pressure vessels, and progress has been made in comparing the effect of two welding techniques on the behaviour in fatigue of fillet-welded joints in high-tensile steel bridge members.

Naval Construction in 1952

By RAYMOND V. B. BLACKMAN

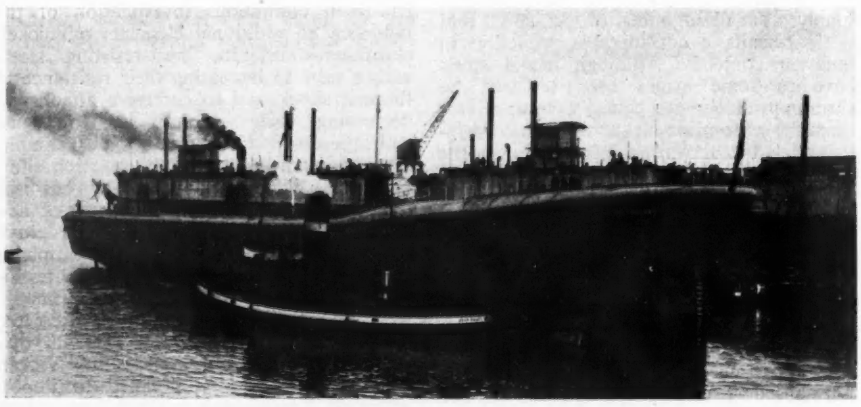
No. III—(*Concluded from page 52, January 9th*)

Canada

LAST July arrangements were concluded for the purchase by Canada of the incomplete light fleet aircraft carrier " Powerful " from Great Britain to replace H.M.C.S. " Magnificent," which has been on loan to the Royal Canadian Navy since her completion in 1948. The " Powerful " has already been mentioned in No. I of this article. The new warship will not be ready for service for some time and the " Magnificent " will be retained in commission by the Royal Canadian Navy in the meantime.

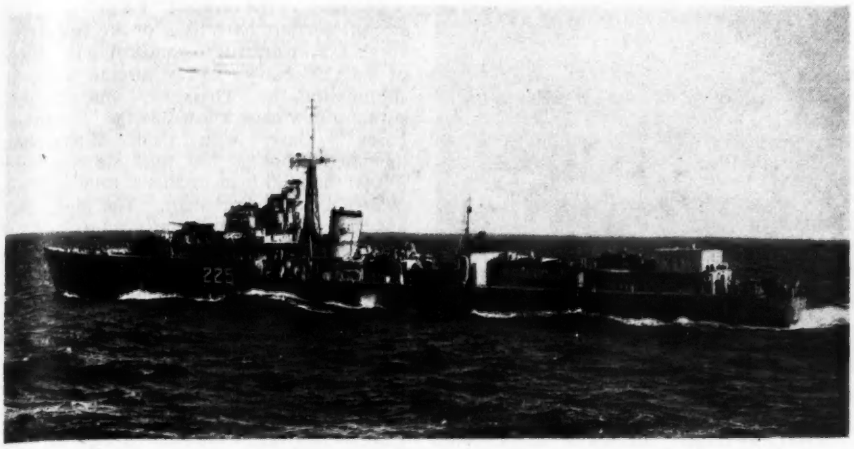
With the resumption of work on the " Powerful," plans have been revised to provide for a completely modern aircraft carrier designed to handle jet aircraft, and she may turn out heavier than the 14,000 tons standard displacement (19,550 tons full load) originally estimated. Modifications will include strengthening of the flight deck and elevators, and improvements in deck arrester gear, as well as the installation of the new British steam catapult capable of launching jet and heavy types of aircraft.

Seven of Canada's new construction anti-submarine escorts have been laid down. The first of this novel frigate warship, the " St. Laurent " (illustrated above), laid down on November 22, 1950, and launched on November 30, 1951, was in an advanced stage of fitting out by the end of 1952 and is expected to undergo her trials in the summer of 1953. She was built by Canadian Vickers, Ltd., Montreal, which is also building a sister ship, the " Ottawa," laid down on June 8, 1951. Halifax Shipyards, Ltd., Halifax, have under construction two more of these ships, officially rated as destroyer escorts, namely, the " Saguenay," begun on April 4, 1951, and the " Margaree," laid down on September 24, 1951. Another pair of " DE's," the " Skeena " and " Fraser," laid down on June 1, 1951, and December 11, 1951, respectively, are being built by Burrard Dry Dock and Shipbuilding Company, Ltd., North Vancouver. The seventh A/S vessel, the " Assiniboine," was begun by Marine Industries, Ltd., Sorel, Quebec, in May, 1952.



" St. Laurent," Canadian New Frigate Under Construction

A later batch of seven escorts are to be built, one by each of the four firms mentioned above and one each by Davie Shipbuilding and Repairing Company, Ltd., Lauzon, P.Q., Victoria Machinery Depot Company, Ltd., Victoria, B.C., and Yarrows, Ltd., Victoria ; and it is officially stated that they will be launched in 1953 and early 1954. All fourteen vessels will have a displacement of 2000 tons and will be armed with rapid-firing 3in A.A. guns of U.S. pattern in two turrets, two single 40mm Bofors A.A. weapons, four 21in torpedo tubes and anti-submarine weapons, including main projector and depth-charge thrower. The



"Sioux," Canadian Converted Fast Anti-Submarine Escort

propelling machinery, of British design, comprises geared steam turbines turning two shafts to give a speed of "over 20 knots." Yarrow and Co., Ltd., Scotstoun, supplied a complete set of machinery for one of these frigates, the others being engined with similar machinery manufactured in Canada. The main turbines and condensers are of English Electric design. The ships will cost 8,000,000 dollars each.

To supplement this anti-submarine flotilla Canada is converting to fast anti-submarine escorts the four destroyers transferred from Great Britain, the "Crescent" and "Crusader" in 1951, and in 1944, the "Algonquin" and "Sioux" (illustrated above.) All four ships displace 1710 tons increased to 2540 tons at full load, and their propelling machinery comprises two Admiralty three-drum boilers and Parsons geared turbines turning two shafts and developing 40,000 s.h.p., equal to a speed of 34 knots. All seven of Canada's improved "Tribal" class destroyers, the "Athabaskan," "Cayuga," "Haida," "Huron," "Iroquois," "Micmac," and "Nootka," have been or are being converted into escort destroyers. They displace 1927 tons standard and 2745 tons at full load, and three Admiralty three-drum boilers supplying steam to a two-shaft arrangement of Parsons geared turbines aggregating 44,000 s.h.p., give them a designed speed of 36½ knots.

No fewer than eighteen Canadian "River" class frigates, which had been discarded during 1946 to 1948, were reacquired by the Royal Canadian Navy in 1952, to be refitted and maintained in reserve. Of 1445 tons displacement and 2360 tons full load, these ships have two triple expansion engines of 5500 i.h.p., developing a speed of 20 knots. Twenty-one fleet minesweepers of the Canadian "Bangor" class discarded after the Second World War were also reacquired by the R.C.N. and refitted. Three of these, of 590 tons displacement (790 tons full load), are driven by 2000 b.h.p. diesels giving a speed of 16 knots, the remaining eighteen vessels, of 672 tons (900 tons full load), having triple expansion engines of 2400 i.h.p. and a slightly higher speed.

Of the fourteen new construction coastal minesweepers of the "Gaspe" class, all named after Canadian straits and bays, the large majority were launched in 1952 and by the end of the year were completed or approaching completion. Extensively built of aluminium, including frames and decks, they have a displacement of 370 tons with an overall length of 140 ft, the propelling machinery comprising a two-shaft arrangement of diesels.

A new loop layer is being constructed by George T. Davie and Sons, Ltd., Lauzon, P.Q., which also built the "Porte St. Jean" (shown below) the first of five new gate vessels trawler design and launched a sister ship, the of "Porte St. Louis," in April, 1952, when the "Porte Dauphin" also took the water. The other two new gate vessels are the "Porte de la Reine" and the "Porte Quebec." They are multi-purpose vessels for operating the gates in anti-submarine booms and laying anti-submarine nets at the entrances of defended harbours, and they are capable of being fitted for minesweeping and several other purposes. They are single-screw vessels, 125ft long, propelled by a diesel and a.c. electric installation.

The new large Arctic patrol vessel and icebreaker being built by Marine Industries, Ltd., Sorel, Quebec, will have a displacement of 5400 tons and a length of 269ft with an armament of several short-range weapons and diesel-electric propelling machinery of 10,000 b.h.p., giving a speed of 16 knots. She will be Canada's largest and most up-to-date icebreaker with steel hull sides about 2in thick and special heating tanks built into her. Another new feature is a special flight deck built aft, which will accommodate a seaplane and provide space for a helicopter to land. The ship will also carry a landing craft strengthened to resist ice formations.

United States

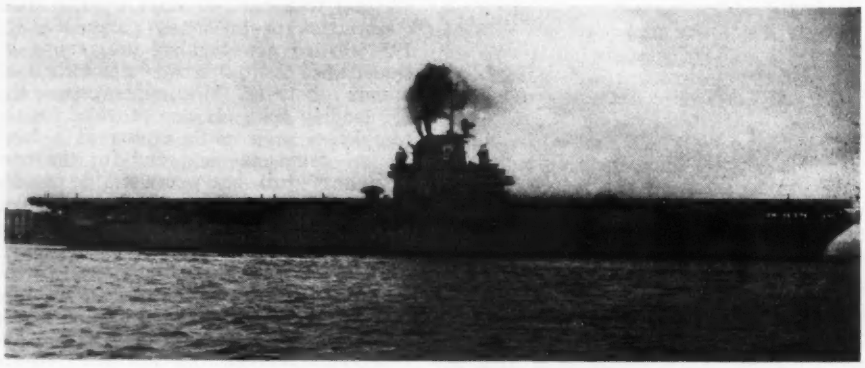
Considerable additions are being made to the strength of the United States Navy, notably by the construction of a few very large units, but chiefly by the mass production of minesweepers and ancillary craft. In addition to some 280 ships already under construction or previously authorised, the 1952 revised new building programme included three destroyers, two ocean escorts, an atomic submarine, thirty minesweepers, and 350 landing craft. It also provided for the completion of a battle cruiser as a large tactical command ship, and for the conversion of two heavy cruisers to guided missile ships.

American Fleet Aircraft Carriers

The keel of the giant fleet aircraft carrier "Forrestal" was laid on July 14, 1952, at the Newport News Shipbuilding and Dockyard Company, Newport News, Virginia. She will be a flush-deck ship having a standard displacement of 59,900 tons and a full-load displacement of about 75,000 tons, with an overall length of 1040ft, and will therefore be the largest and longest warship in the world. She will have a waterline beam of 128ft with an extreme flight deck width of 252ft. Her main propelling machinery, ordered from the Westinghouse Electric Corporation, will comprise four steam turbines developing a speed of about 33 knots. The flush deck of this new aircraft carrier will present an unobstructed surface for aircraft landing and take-off. The vessel will have a retractable bridge or island superstructure and the latest electronics equipment for assisting aircraft operations. Particular attention has been paid to design characteristics, which will aid in replenishment at sea, in order that the new carrier can operate for long periods without returning to port. To improve her seakeeping capabilities the bow will be completedly enclosed up to the flight deck. This is evidently a concession to the advantage of the design of British aircraft carriers in which the bows have always sheered up to meet the flight deck (except the early converted carriers). The "Forrestal" has been designed to accommodate the heavier, faster jet aircraft of the future. Her size has been determined not only by the attack aircraft she will carry, but by the size of her fighter complement as well. She must carry fighter aircraft capable of coping with the enemy fighters she may encounter, in addition to carrying the latest attack aircraft. It was officially stated that the "Forrestal," with its fighter aircraft, shipboard anti-aircraft batteries, high manœuvrability and resistance to damage —plus the fire power of the cruisers and destroyers in its task force—will present one of the most highly defended and elusive targets an enemy could attack.

Even before the keel of the new carrier was laid down the Department of Defence stated that "progress on the ship so far indicates

"Porte St. Jean," Canadian New Gate Vessel



"Essex," U.S. Reconstructed Aircraft Carrier

that launching will take place in March, 1954, and that the end of construction will be in December, 1954, only twenty-nine months after the laying of the keel." The "Forrestal" will have four elevators and four catapults, and three separate launching areas for aircraft. The design calls for a flight deck about 80ft longer than that provided in the largest existing carriers of the "Midway" class, as compared with which she will have an increased arresting capacity and higher hangar decks with a headroom of 25ft. to accommodate aircraft of supersonic speed with their high tails. The ship will also have the British type of steam catapults.

The immense size of the ship will enable her to carry effective armour protection against explosion and atomic blast, as well as about 100 aircraft, the exact number depending on the type. There will also be improved underwater protection and extensive compartmentation of the hull to keep the ship afloat even when hit by several torpedoes. To meet the requirements of present and future aircaft of increased size, weight and speed the new ship will have stronger decks than previous aircraft carriers and will have increased protected stowage for aviation fuel. Since new aircraft can carry heavier conventional bomb loads as well as guided missiles and atomic bombs the "Forrestal" will have great store space for aviation ordnance, and because operational requirements dictate catapult rather than deck launchings of fighters in the future she will be able to launch as many as thirty-two interceptor aircraft in as few as four minutes. Her flight deck will be made of steel.

The "Forrestal" will be too big to pass through the Panama Canal, but as she is the first of two or three of a new class it would be logical to have one or more in each of the Pacific and Atlantic oceans. The new carrier is estimated to cost 218,000,000 dollars, or about £77,857,000.

A sister ship of the "Forrestal" to be named "Saratoga" was laid down at the New York Naval Shipyard, Brooklyn, on December 16th. The word fast has been applied in the description of this ship's characteristics more than in that of the "Forrestal." According to the Secretary of the Navy improvements in machinery will make her capable of "somewhat higher speeds." She is reported to have been designed for a speed of 35 knots. Early in December it was announced that the Secretary of Defense had approved American Navy plans for laying down a third aircraft carrier of 60,000 tons in 1953.

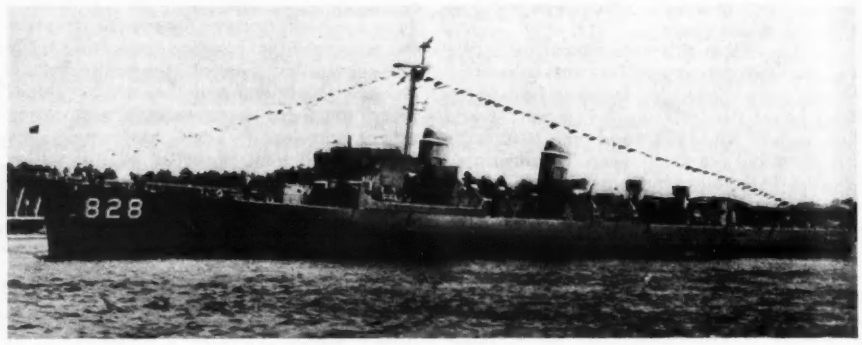
To obtain authorisation for the second outsize carrier in 1952, the Navy Department had to shelve plans for the construction of an escort carrier as well as a large destroyer, an ocean escort vessel, two submarines, three dock landing ships and two fleet oilers, and also six destroyer escort conversions.

"Mitscher," U.S. New Destroyer Leader

Fourteen of the original "Essex" class fleet aircraft carriers have been or are being converted (as illustrated) to conform to the design of the U.S. Navy's newest aircraft carrier in commission, the "Oriskany," and now constitute a new class known as the "Improved Essex" class, with their displacement increased from 27,100 tons standard and 33,000 tons full load to 30,800 tons light and 39,800 tons at deep load. The flight deck has been extended and reinforced to facilitate the operation of large aircraft, with a stronger runway, heavier handling gear, bigger lifts, more powerful catapults, increased stowage for petrol, smaller island superstructure, and modified battery of eight 5in dual-purpose guns, twenty-eight 3in anti-aircraft weapons, and seventy-two 40mm A.A. pieces. Large bulges on the hull offset the extra weight thus added. Eight Babcock and Wilcox boilers and four sets of geared turbines developing 150,000 s.h.p. give them a speed of 33 knots. It is intended to modernise the remaining nine units of the "Essex" class eventually.

Command Ships

From decisions made in 1952 an entirely new category of large warship is proposed for the U.S. Navy. It might best be described as a professional flagship. Instead of using an operational ship of a task force as a flagship, that is superimposing the direction of an admiral and his staff, with the necessary equipment and accommodation, on a functional warship, which detracts from the usefulness of its specific category and the role for which she was designed, a special type of war vessel is being evolved for the sole purpose of tactical command and fleet administration. The "Hawaii," "CB 3," originally designed as a "large cruiser" or battle cruiser, and launched in March, 1945, but never completed, is to be converted to the first "large tactical command ship." The initial plans of the "Hawaii" provided for a displacement of 27,500 tons standard and 34,250 tons full load with a length of 808½ft, a beam of 91ft, and an armament of nine 12in guns, twelve 5in weapons and ninety anti-aircraft pieces of 40mm and 20mm calibre. In the proposed conversion, which includes the installation of a great deal of radar, communications and other equipment to fit her for the express purpose of acting as a command ship and directing the movements of an aircraft carrier task force or similar large fleet or group of warships, the largest guns mounted will be of 5in calibre. She will be propelled by a four-shaft arrangement of General Electric geared turbines of 150,000 s.h.p. fed by eight Babcock and Wilcox boilers and developing a speed of 33 knots.



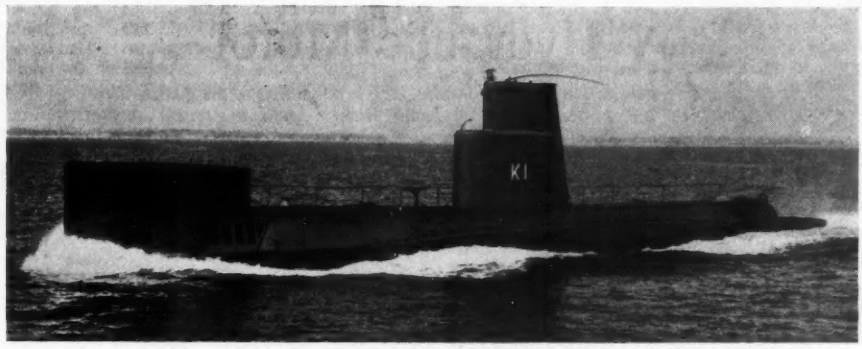
"Timmerman," U.S. New Experimental Destroyer

At the end of 1952 the U.S.S. "Northampton" was being completed as a smaller

type of tactical command ship. This vessel was originally designed as a heavy cruiser of the " Baltimore " class and was laid down on August 31, 1944, but her plans were recast and she was to have been resumed as one of the modified " Oregon City " class heavy cruisers. She was 56 per cent constructed as such when she was cancelled on August 11, 1945. On July 1, 1948, however, she was reordered and redesigned as a Task Force Command ship and her equipment and accommodation were modified accordingly. She was launched at the yard of the Bethlehem Company, Quincy, Mass., on January 27, 1951, and was due to commission on November 30, 1952, as a tactical command ship to fulfil the same functions as an amphibious force flagship, or operations, communications and headquarters vessel, but with more speed, manœuvrability, armament and anti-aircraft fire power. She is fully air-conditioned. Her main armament comprises four 5in dual-purpose guns and eight 3in heavy anti-aircraft weapons. She has a standard displacement of 17,000 tons, is 676ft long overall with a beam of 71ft, and draws 25ft of water ; and her armour includes 6in sides with 3in and 2in decks. Her propelling machinery consists of General Electric turbines, taking steam from eight Babcock and Wilcox boilers, turning four screws and developing 120,000 s.h.p., designed for a speed of 33 knots.

The so-called Destroyer Leader, " Norfolk," formerly rated as a " Cruiser, Hunter-Killer Ship," was also nearing completion at the end of 1952. She was laid down on September 1, 1949, by the New York Shipbuilding Corporation, Camden, New Jersey, and took the water on December 29, 1951. Her displacement is now given as 5500 tons standard with an overall length of 540ft and a beam of 54ft. Unofficially her maximum speed is reported to be 34 knots. She was designed as a special category of anti-submarine vessel of cruiser size and entirely novel type to engage in hunter-killer operations even in the worst weather, and she incorporates in her construction features resulting from lessons learned at Bikini. Now expected to be commissioned before March, 1953, she cost 44,000,000 dollars, exclusive of armament.

Four smaller destroyer leaders (but, nevertheless, the largest destroyers ever built in the United States, and in the world, and larger than some ships rated as light cruisers in other countries) were due to be delivered to the U.S. Navy by the end of 1952. They are the " Mitscher " (opposite) and " John S. McCain," launched by the Bath Ironworks Corporation on January 26 and March 29, 1952, respectively, and the " Willis A. Lee " and " Wilkinson " launched by the Bethlehem Company, Quincy, on January 26 and April 23, 1952, respectively. They are of 3675 tons standard displacement and 4400 tons full load, and have an overall length of 493ft with a beam of 50ft. The propelling machinery, which is designed for a speed " in excess of 30 knots," includes many advanced engineering features not previously installed in fighting ships. The new vessels are officially described as of a class considerably larger than regular destroyers with additional communication, electronic and combat information centre equipment to render them capable of co-ordinating the vessels of anti-submarine screens protecting convoys and to perform other destroyer-leader tasks. This is in addition to their superior ability as combat vessels in their own right. The cost of each vessel, as revised, is 29,500,000 dollars, exclusive of ordnance.



" K1," U.S. New Hunter Killer Submarine

After considerable delay the U.S.S. " Timmerman " (illustrated opposite) the first ship of post-war construction for the U.S. Navy, was completed and commissioned on September 26, 1952. The ship was completed to a new design and was officially described as the prototype of a new class, but it is not now anticipated by the U.S. Navy that the advances made in the design of the new vessel will prove to be totally acceptable or practical in ships to be mass-produced in case of emergency.

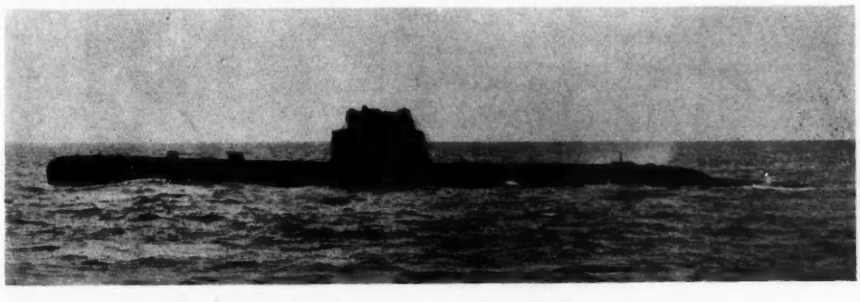
The keel of the " Timmerman " was laid on October 1, 1945, at the Bath Iron Works Corporation Yard, Bath, Maine, and she was launched on May 19, 1951. A reduction in weight far beyond anything previously attempted has been effected in this vessel to determine to what extent steam and electrical machinery for naval use can be lightened without loss of reliability. The propelling machinery utilises higher temperatures and pressures than usual.

Three orthodox destroyers are projected under the 1952–53 new construction programme, but they will be larger than all previous vessels of this category with a displacement of 2850 tons. And three or more ocean escorts are to be built, the first of which is the " Dealey," ordered from the Bath Iron Works. They are officially described as prototypes for new and modern anti-submarine vessels and approximately correspond with the new British frigates under construction. They are capable of being mass-produced and are to be lavishly equipped with electronic gear. They will displace 1450 tons and will cost 15,000,000 dollars each.

Of the six new high-speed attack submarines of the " Tang " class (illustrated below) five were completed. The designed standard displacement was 1615 tons, but the actual surface displacement is now given as 1800 tons. With a length of 268ft overall, they carry six 21in torpedo tubes and diesel-electric propelling machinery gives them a speed of over 17 knots. They are streamlined deep-diving vessels with comparatively short hulls, and are reported to be faster under water than on the surface.

Three medium-sized submarines, " Submarine Hunter Killers " (illustrated above), also entered service early in 1952. They are of 765 tons standard displacement with an overall length of 196ft. They have an ungainly square prow full of listening gear and the newest electronic and sonar detection equipment, and a short hull which makes them highly manœuvrable and suitable for ambushing other submarines. They are armed with target-seeking torpedoes.

The contract for the construction of the second nuclear-powered submarine which, it has just been announced, will be named " Sea Wolf," has been awarded to the Electric Boat Division of the General Dynamics Corporation, Groton, Connecticut. She will have her nuclear-powered propulsion machinery built by the General Electric Company. A land-based prototype of this machinery is being erected at West Milton, New York. Her nuclear power plant will be of different design to that installed in the " Nautilus," the first nuclear-powered submarine which is being constructed by the Electric Boat Company and engined by Westinghouse Electric Corporation. The " Sea Wolf " will operate with a liquid metal coolant, while the " Nautilus " will be equipped with a water coolant. Both vessels will have a submerged displacement of about 2500 tons and each will cost about 40,000,000 dollars. The " Nautilus " was laid down in June, 1952. She is expected to be launched in 1954. Her engine alone will cost 25,000,000 dollars.



" Tang," U.S. New Attack Submarine

Book of Reference

Mechanical World Year Book, 1953. Manchester : Emmott and Co., Ltd., 13, King Street, West, 3. Price 3s. 6d.—The useful reference book is now in its sixty-sixth year of publication and the new edition follows closely the lines of its predecessors. In addition to the usual detail revision to keep the book up to date a new chapter on the design of springs has been introduced. This chapter is by Dr. W. R. Berry, and is based on the articles on his work published in the pages of *Mechanical World and Engineering Record.*

A Hydraulic Motor

As the characteristic action of the hydraulic jack is not suited to the comparatively long travel of the Fowler flap now being widely fitted to recent aircraft, interest has been stimulated in rotary winding mechanisms. The hydraulic motor described has been developed by British Messier, Ltd. Pressure fluid is admitted to cylinders with cam-operated slide valves, so arranged that the pistons are disposed to thrust sequentially on a swash plate mounted on the output shaft. The unit weighs 14·3 lb and develops 15·8 h.p. at 2500 r.p.m., the fluid pressure being 4000 lb per square inch.

HYDRAULIC motors have not been used widely on British aircraft, as it has generally been found more convenient to make use of normal hydraulic jacks to operate flaps, bomb doors, &c., by means of some mechanical linkage. The wider use of Fowler type flaps, however, has recently stimulated interest in electric or hydraulic winding mechanisms which can operate this kind of flap over a comparatively long travel. It has been found that hydraulic jacks of the normal form are rarely suitable for such mechanisms. Prior to the development of the hydraulic motor described herewith the only equipment which was available for operating such flaps were large electric actuators which are extremely heavy, and invariably have very short time ratings.

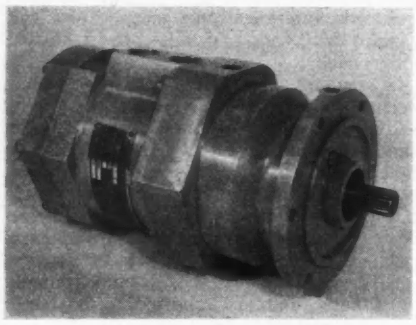


Fig. 1—Complete 15·8 h.p. Hydraulic Motor

The present motor, which has been developed by British Messier, Ltd., Gloucester, is being fitted to several new aircraft. It develops approximately 15·8 h.p. at 2500 r.p.m. and weighs only 14·3 lb. This rating has been proved on type tests over fifty hours' running and the unit is therefore fully continuously rated. For short periods of time it can be operated at appreciably higher outputs. An advantage of hydraulic motors as compared with ordinary electric motors is the extremely high torque–inertia ratio. The speed of reversal of the motor when the hydraulic connections are reversed is virtually instantaneous, any delay being of the order of a few milliseconds due to the slight compressibility of the fluid.

The unit is shown in Fig. 1 and it will be noted that the motor is flange mounted and can be installed in any position, preferably lower than the oil reservoir. In cases when the latter is inconvenient, special provision can be made.

Specification

Cylinder bore dia.	0·53in
Cylinder stroke (swash plate angle 13½ deg.)	0·672in
Number of cylinders	5
Swept volume per revolution	0·741 cu in
Maximum pressure	4000 lb/sq in
Torque at 4000 lb/sq in	400 lb-in
R.p.m. (max.)	2500
Output h.p. at 4000	15·8
Direction of rotation	Reversible

Figs. 2 and 4 illustrate a cross section of the unit and the principle of its operation. There are five piston assemblies which operate on a swash plate formed by an ordinary thrust ball race. The swash plate is inclined to the axes of the output shaft on which it is mounted, and when the oil is fed into the five cylinders in an appropriate sequence the swash plate is made to rotate. The admission and exit of oil to and from the cylinders is controlled by a series of five small slide valves one for each cylinder, which are reciprocated by means of a pair of cams so arranged that the correct timing is obtained.

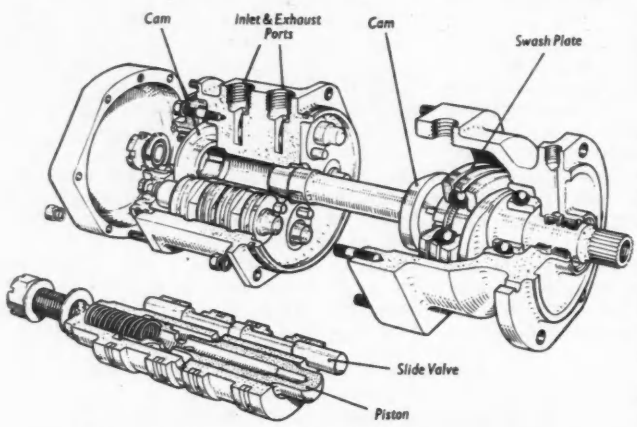


Fig. 2—Sectional Views of the Motor and Piston Assembly

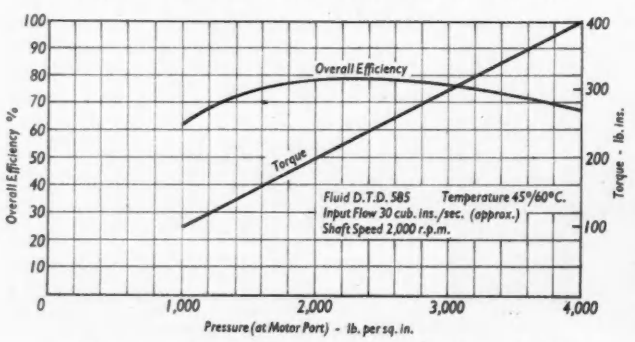


Fig. 3—Pressure/Overall Efficiency and Pressure/Torque Graphs

The piston and valve assemblies are each mounted inside a cylinder assembly which has two bores, the whole forming a sub-assembly.

The unit is capable of delivering a maximum torque of 400 lb-inches over a speed range of 300 to 2500 r.p.m., giving a horsepower range at maximum pressure (4000 lb per square inch) of 1·9 to 15·8. Output torque is directly proportional to the input pressure and the speed directly proportional to the input flow.

Test and Performance

A production unit, having been run in and proof tested, was submitted to extensive and varied tests, including static and endurance tests, summaries of which are given below, and in graphical form in Figs. 3 and 5.

For the endurance tests the motor was directly coupled to a pump, which acted as a loading medium. The motor ports were fed through a reversing valve, and the motor was reversed every fifteen seconds. These reversals were carried out 10,000 times with an inlet pressure of 2400 lb per square inch throughout the total running time of 52½ hours; the motor ran without fault. The unit was calibrated before and after this test, by means of a dynamometer. The calibration figures are tabulated below and show that performance was maintained throughout the endurance test:

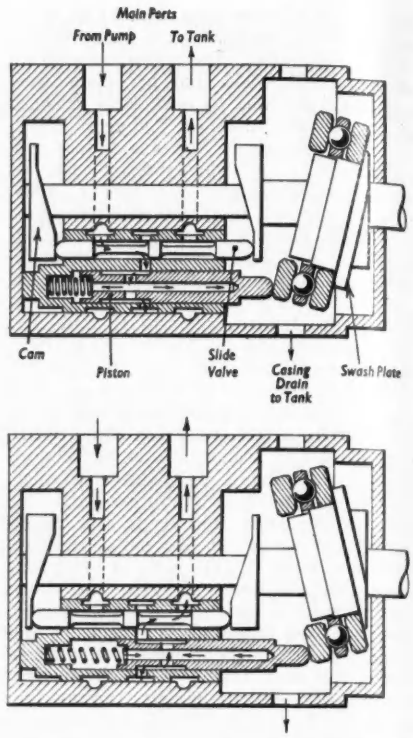


Fig. 4—Cross Section showing Principle of Operation

Initial and Final Calibration Table

Calibration	Pressure	R.p.m.	Fluid temp., deg. Cent.	Torque, lb-in	
				Initial	Final
Clockwise	1200	2000	48	107·5	106
	2500	2000	50	251	249
	4000	1880	51	401·5	385
Anti-clockwise	1200	2000	45	106	107
	2500	2000	48	251	253
	4000	1890	55	401	400

Low-Temperature Test.—The motor was refrigerated to a temperature of −60 deg. Cent. in order to determine the low-temperature starting torque. It was established that the inlet pressure required at this temperature to start the motor rotating was 86 lb per square inch.

Static Tests.—Leakage of fluid through the motor from one port to the other was determined by locking the shaft to prevent rotation and

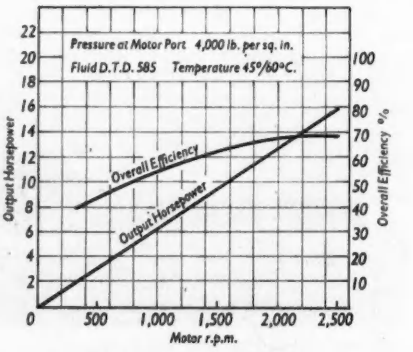


Fig. 5—Performance Graphs

applying a pressure of 4000 lb per square inch at one port. Leakage from the other port was 710 c.c. per minute, and with the port reversed 600 c.c. per minute. (Allowable leakage, 1000 c.c. per minute.) In a low-pressure test, the motor was totally submerged in oil, with the main ports sealed; 20 lb per square inch air pressure was applied at the casing drain, and there was no leakage. The pressure required to nitiate shaft rotation was 18 lb per square inch.

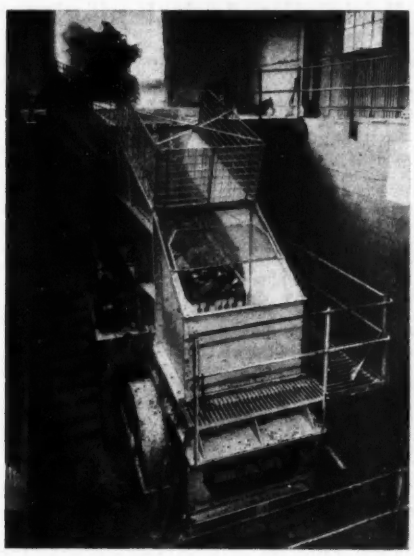
A Chalk Crushing and Screening Plant

WE have received particulars of a new crushing and screening plant, designed and built by the Fraser and Chalmers Engineering Works of the General Electric Company, Ltd., which is now in operation at the chalk quarries of the Chinnor Cement and Lime Company, Ltd. This plant is designed to handle up to 70 tons per hour of dry material containing pieces of chalk 24in square by 36in.

Chalk excavated from the quarry is transported to the plant by 5 ton dumpers, which tip the material into a steel receiving hopper at the feed end of one of the two main buildings in which the plant is located. A dumper can be seen tipping its load in the photographs of the plant reproduced on this page. A moving bar grizzly feeder at the end of the hopper feeds the chalk into the crusher. This feeder, to be seen in the second illustration, is 4ft wide and 15ft long. It removes the fines ahead of the crusher, the fines falling on to a belt conveyor below.

The single-roll "Pennsylvania" crusher installed can be adjusted to give products from minus 9in to minus 5in, and it has a 30in diameter manganese steel-toothed roll 50in long, driven at 35 r.p.m. by a 65 h.p. slipring motor. Material from the crusher together with the undersize from the grizzly then passes along a 30in inclined belt conveyor 156ft long to the screening section of the plant in the second building. This conveyor is driven through reduction gearing by a 10 h.p. high torque squirrel-cage motor. It is fitted with three-pulley troughing idlers, having tapered roller bearings and mounted on steel boards, the idlers at the feed end being of heavy rubber-cushioned design and spaced at not more than 2ft centres under the single-roll crusher. The return idlers are also equipped with tapered roller bearings, whilst the head, tail and snub pulleys are supported on roller bearings. A weighted belt cleaner and a pawl and ratchet hold-back gear is fitted to the conveyor.

The conveyor discharges on to a "Gyrex" screen, from which the oversize and the undersize materials are fed into two separate hoppers. A flopper valve is provided to enable the screen to be by-passed when necessary and direct all the material into the undersize hopper. The screen undersize passes to the adjoining wash mill of the cement plant, whilst the oversize is discharged by means of a chain feeder into 1 cubic yard capacity wagons for transport to the lime kilns. The 30in wide chain feeder is fitted with a variable speed reducing gear, driven by a 2 h.p. motor. Frequently all the chalk is diverted to the cement plant, in which case the screening operation is omitted.

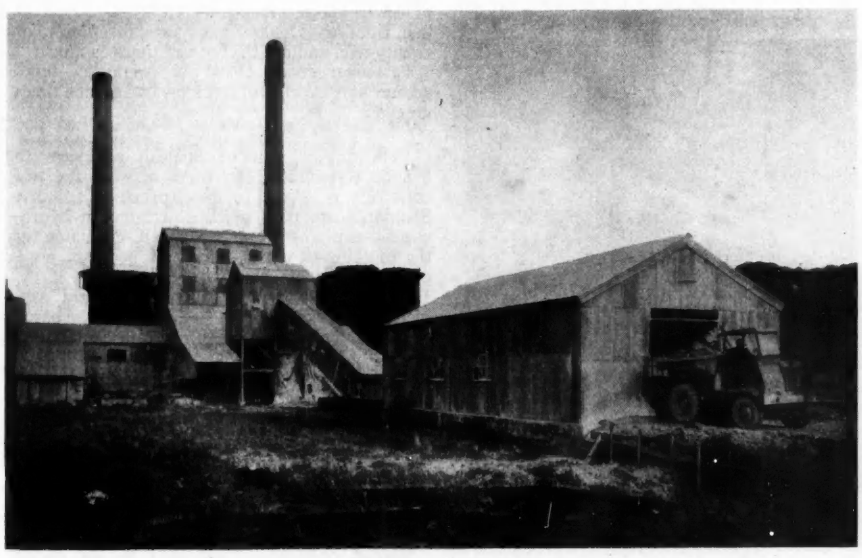


Dumping Platform, Hopper and Grizzly Screen

The heavy "Gyrex" screen employed at Chinnor has an eccentric vibration shaft of large diameter supported at its ends in self-aligning double roller bearings bolted to the screen base. Through a tubular casting rigidly fastened to side plates of the live frame the frame is given a circular motion of a stroke equal to twice the eccentricity of the shaft. Counterbalanced weights are provided with means of precise adjustment to prevent the transmission of vibration to surrounding structures.

The discharge to the wash mill is regulated by means of a 30in dia. by 62in wide roll feeder, an auxiliary chute being provided so that all the material can, if required, be emptied into wagons through a radial gate.

The two plant buildings have rolled steel framework with galvanised steel sheeting. For plant servicing purposes a 5-ton double girder hand-operated travelling crane with a span of 24ft and running on rails 25ft above floor level is mounted in the crusher house. A hand-operated 2-tons-capacity travelling block worm gear serves the length of the screening house.

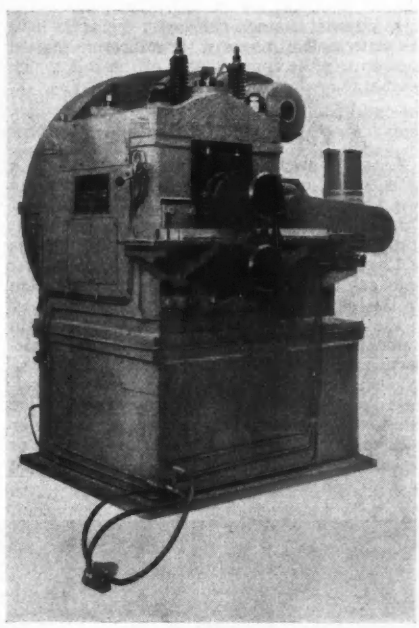


Chalk Crushing and Screening Plant

Reducer Rolls

WE have received from Eumuco (England), Ltd., 12, Great Portland Street, London, W.1, particulars of a new machine it has added to the range of plant it manufactures for the forging industry. This machine is a reducer roll which is used in preparing material prior to the actual forging operations on hammers, presses or upsetters. By using such a machine for the initial breaking down operation it is claimed that material can be saved and the actual forming can be done with fewer strokes on the final machine without need for reheating of the material.

The new machine is made in various sizes, with 8in, 10in, 12in and 15in rolls corresponding to bar diameters of 1¼in, 2¼in, 3in and 4in,



10in Reducer Rolls

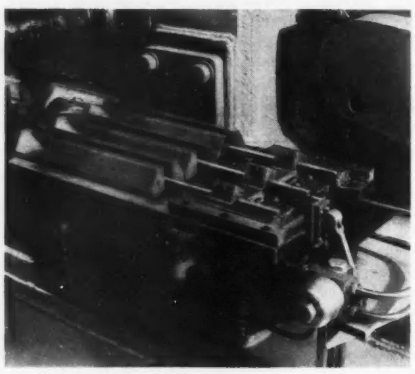
and heavier capacity machines can be made to special requirements. One of the 10in diameter roll machines is illustrated above.

On these machines full round rings are used as compared with the half-rings used mostly on gap roll type machines, and practically the whole circumference of the roll can be used as only a small amount has to be cut away for feeding-in purposes. As the rolls are mounted on shafts outside the housing they are easily accessible and profiles can be changed in a very short time. Designed essentially for single-stroke working, the machines are fitted with air-operated clutches and brakes designed to bring the rolls to a standstill in the proper position after each working pass.

The upper roll shaft is adjustable for height so that the correct centre distances can be set, and overload safety means are provided to prevent

damage to the mechanism or rolls. An operator's pedal can be set in any convenient position for working from the front or rear of the machine and an inching device is fitted for use when setting-up the rolls. Although the machine is designed for high-speed operation, working strokes cannot be repeated until the operator releases the control pedal and deliberately restarts the cycle. If continuous running is required for special purposes means can be provided.

Adjustable tables carrying fixed guides are



Rear Guide Table and Starting Control Valve

attached to the front and rear of the rolls and the above illustration shows one arrangement of a rear guide table. On the particular roll used with this table three profiles are provided and it is equipped with a starting gear which is automatically operated when the workpieces are fed into position on the table. When the three adjustable stock gauges on the table have the material fed in against them they are pushed back to trip the control valve of the roll, which is set at the rear of the table.

A Portable Power Loader

A NEW power loader suitable for handling bales, sacks, crates, &c., is now being made in two sizes by R. A. Lister and Co., Ltd., of Dursley, Glos. These loaders are made in 16ft and 24ft platform lengths, with delivery heights of 12ft and 18ft, respectively. One of the shorter units can be seen in operation in the illustration on this page.

The loaders have fabricated rolled-steel main frames rigidly connected by box-section cross-bars, and supporting a moving platform of wooden slats bolted to heavy welded steel-linked chain. The slats which carry the load are fitted with removable angle irons, which can be used to advantage when loading cases, bales or sacks. When it is required to deal with unpacked materials an adjustable attachment can be fitted to the slats. The wooden side-boards fixed to each side of a loader are useful when handling such things as bagged goods, but they can be removed to make a wider platform available when required.

The loaders are of light construction and are so balanced on their two pneumatic-tyred carrying wheels that one man can easily move and set them in position. The angle of the platform is adjusted by means of a mechanically operated telescopic tube and during loading operations stability is ensured by the positioning of a telescopic stand connected to the adjustment unit.

A 2¾ h.p. petrol engine or electric motor drive is fitted to the loaders and the moving platform is driven through two vee belts. Starting and stopping of the platform is by means of a combined belt guide jockey pulley and a clutch and its approximate speed is 100ft per minute.

British Standards Institution

All British Standard Specifications can be obtained from the Sales Department of the Institution at 24 Victoria Street, London, S.W.1.

GREEN PROTECTIVE SPECTACLES AND SCREENS FOR STEEL WORKS OPERATIVES

No. 1729 : 1952. This standard specifies protective spectacles and screens suitable for use by steel works operatives, with a view to providing comfortable vision and protection against possible injury to the eyes from harmful radiation. The standard provides also for the colour matching of pairs of lenses so that broken glasses can be replaced without affecting the wearer's ability to judge furnace conditions.

Eye-protection filters, either as lenses or as shields, are necessary for viewing industrial operations in which radiation of high intensity is emitted—for example, welding, the collection of molten glass and steelmaking and working. This radiation is commonly divided into four categories : infra-red, light, ultra-violet and total heat. An important purpose of the filter is to protect the eyes of the wearer against injury from the infra-red and ultra-violet radiation emitted.

The filters commonly used by those engaged in steel melting and working have been made of cobalt blue glass, which, by virtue of its blue and red transmission characteristic, aids visual assessment of temperature. Little protection against infra-red radiation is given, however, because of the relatively high transmission factor of cobalt blue glass in the near infra-red part of the spectrum. Furthermore, in manufacture it is difficult to control the transmission factor of this blue glass and a melter whose protective spectacles are broken finds it difficult to match them.

The particular advantages of the green glass are summarised as follows :—Green glasses protect wearers against harmful infra-red radiation while the blue filters do not ; they are more comfortable in use than the blue glasses because of the lack of chromatic aberration, and green glasses can be replaced by a pair from stock without affecting the wearer's judgment of furnace conditions. Price 2s. 6d.

Portable Power Loader in Operation

French Engineering News

(By Our French Correspondent)

An atomic energy industrial commission has been set up to instigate the use of atomic energy in French industry. The commission will undertake the construction of two graphite piles for the production of plutonium. This will be followed by a series of experiments and a plan for the development of atomic power for industrial purposes. Members of the new committee include Monsieur Armand, of the French Railways ; Monsieur Ailleret, of the Electricité de France ; Monsieur Denville, of the potassium and chemical industries ; Monsieur Noguet, of the Ateliers et Chantiers de la Loire, and Monsieur Réné Perrin, of the Société d'Electro-Chimie, Electro-Metallurgie et des Acieries Electrique d'Ugine.

* * *

The Electricité de France has announced that at the Arrighi electric power plant at Vitry-sur-Seine there is to be installed a new turbo-alternator now being constructed by Alsthom, of Belfort. This 110MW hydrogen-cooled alternator will have a stator 7m by 4·20m high and 4·40m wide, built in one piece. It will weigh 182 tons, and special transport has had to be built to carry the alternator from Belfort to the plant at Vitry.

* * *

The dam at Bin El Ouidane, construction of which was started in 1948, has been completed, and the artificial lake will be filled shortly. This dam is of the greatest importance to Morocco, as its hydro-electric plant will produce 550 million kilowatt-hours per year and its water will be used to irrigate at least 280,000 acres of dry land. The lake formed by the new dam is 25km long and 5km wide, and has a capacity of one milliard 500 cubic metres of water. This plant has three turbo-alternator sets of 40,000kW. A second dam has been built about 3km downstream from the first to equalise variations in flow of water from the Bin el Ouidane plant.

The question of the cost of locomotives has been raised in France and the Syndicate, representing the builders, has repudiated the statement that French locomotives cost too much. An inquiry being made by the Ministry of Public Works shows that according to general estimates a locomotive built in 1952 costs thirty-four times as much as it did in 1939. This is considered excessive by the Ministry, which is responsible for the French railways.

Examination shows that comparisons are not easy to make owing to design developments. The nearest estimate arrived at follows a comparison between two electric locomotives of 1500V; one built in 1939 developed 2055 h.p. and another built in 1952 developed 2500 h.p. Manufacturers state price comparisons should take into consideration the horsepower of the locomotives. For example, in 1939, the builders say that a locomotive cost 1684 francs per horsepower to make, whereas in April, 1952, the cost had risen to 42,300 francs per horsepower, or twenty-five, and not thirty-four, times as much.

Passenger coach costs are twenty-six times greater and the cost of trucks is twenty-one times greater.

* * *

Following a visit of Spanish engineers to France a system of exchanges between the two countries is likely to be worked out. The Spaniards are particularly interested in hydro-electric equipment and, above all, estimates for the building of dams. They pointed out, however, that orders could only be placed if the French were willing to accept long-term payments. The exchange method is likely to be based upon similar systems operating with Switzerland and Italy. Spain will supply France with electricity during certain peak periods during the year. Further, if France is prepared to supply equipment for the modernisation of the iron mines it will be allocated a quota of the ore. An economic liaison committee between France and Spain is to be set up to examine all possibilities of the scheme in order to assure the smooth working of any exchange which might be decided upon.

Special committees will also be set up to examine specific exchanges such as railway material, and electric equipment.

Industrial and Labour Notes

Europe's Steel Production

The United Nations Economic Commission for Europe has published this week its *Quarterly Bulletin of Steel Statistics for Europe*. Although the figures given in it do not go beyond the third quarter, the Economic Commission has estimated that crude steel output in Europe (excluding Russia) last year amounted to the record total of 73,870,000 metric tons, or about 9 per cent more than in 1951. The estimates made by the Commission indicate that Belgium and Luxembourg maintained last year the record levels of crude steel production achieved in 1951, and it is also stated by the Commission that in the United Kingdom, "the highest annual pig iron output to date enabled the record level of steel production of 1950 to be substantially regained." In Western Germany the level of steel output last year has only been exceeded in 1938 and 1939.

Pig iron production in Europe, according to the *Bulletin*, totalled 53,000,000 tons in the first three quarters of last year, compared with 49,100,000 tons for the corresponding period of 1951. Compared with 1951, pig iron production last year in Western Germany increased by 21 per cent, in Italy by 11 per cent, in Sweden by 20 per cent, and in the United Kingdom by 9 per cent. Other tables in the *Bulletin* deal with iron ore production. It is shown that in eleven of the more important European countries for which information is available iron ore output increased from 65,800,000 tons in the first three quarters of 1951 to 76,300,000 tons in the comparable period of last year, a rise of 16 per cent. The countries and the percentage increases are: Austria 12 per cent, France 17 per cent, Western Germany 17 per cent, Italy 57 per cent, Luxembourg 38 per cent, Norway 93 per cent, Spain 28 per cent, Sweden 8 per cent, Turkey 43 per cent, the United Kingdom 8 per cent, and Yugoslavia 22 per cent. The Commission says that the considerable increases in France, Western Germany and Luxembourg, taken in conjunction with the relatively modest rise in Sweden, indicate a substantially higher proportion of low-grade ore in the total European output. About coke-oven coke production, the *Bulletin* says that output in the first three quarters of last year was, at 61,000,000 tons, about 10 per cent greater than in the corresponding period of 1951.

Employment and Unemployment

In a report on the employment situation in Great Britain, the Ministry of Labour has stated that, at the end of November last, the total working population numbered 23,404,000 (16,010,000 men and 7,394,000 women). This indicates a net increase of 10,000 during the month, a decrease of 10,000 men being offset by an increase of 20,000 in the number of women included in the working population.

The number of people in civil employment at the end of November was 22,155,000 (14,921,000 men and 7,234,000 women), which was 6000 more than at the end of the preceding month. Here again, however, the net increase is explained by the fact that the November total included 20,000 fewer men and 26,000 more women. The total in civil employment included 4,079,000 in the country's basic industries, which was 32,000 less than at the end of October. The principal reductions in this group of industries were obviously seasonal, as they occurred in transport and agriculture. There was no change in November in the figure for mining manpower, the number of wage-earners on colliery books being 719,000. In the manufacturing industries the total number engaged at the end of November was 8,650,000, or 20,000 more than a month earlier. Here, the increases occurred principally in the textile and clothing industries. In the manufacturing group classified as "engineering, metal goods and precision instruments" there was a drop of 3000, the number employed at the end of November being 2,561,000. The labour forces of the vehicle and metal manufacturing industries remained at 1,090,000 and 558,000 respectively. In building and contracting there were 1,436,000 at work at the end of November—or 3000 less than in October—and in "professional, financial and miscellaneous services" 3,948,000 people were engaged, which was 12,000 fewer than in October.

The latest figures from the Ministry of Labour on unemployment relate to December 8th last, when 399,461 people were registered as out of work, compared with 406,366 on November 10th. The December figure included 74,550 married women and 31,869 men and women described as "temporarily stopped." The Ministry's report also states that, in the week ended November 29th last, there were 99,000 operatives in the manufacturing industries who were reported to be on short time, losing twelve and a half hours each on the average, whilst 1,282,000 operatives were working, on the average, seven and a half hours overtime.

Britain's Overseas Trade

Provisional figures of the United Kingdom's overseas trade in December show that exports were valued at £203,700,000, compared with £207,200,000 in November. Imports into the United Kingdom in December have been valued at £267,700,000, and re-exports at £7,500,000, so the excess of imports (c.i.f.) over total exports (f.o.b.) at the end of the month was £56,500,000, compared with an average of £40,700,000 for the two months of October and November.

Provisionally, the total value of exports for last year has been put at £2550 million, a decrease of £30,000,000 (or 1 per cent) compared with 1951. The Board of Trade says that the exceptionally high level of exports achieved in the first quarter of last year was followed by a considerable reduction in the succeeding months. Imports last year reached a total of £3481 million, which was £422 million, or 11 per cent, below the 1951 total. The value of imports last year, however, was much higher than in 1950, when the figure for the year was £2608 million. Re-exports last year were valued at £144 million, compared with £127 million in 1951. Over the whole of last year the excess of imports over exports and re-exports was £409 million, or one-third less than in 1951.

Britain's Place in World Markets

The chairman of Martins Bank, Ltd., Mr. A. Harold Bibby, has circulated a statement reviewing the affairs of the company during the past year. In the course of the statement Mr. Bibby comments on this country's export business, saying that "if we try to press our self-appointed rights out of line with self-imposed efforts we shall inevitably price ourselves out of world markets." A glimmering of this, Mr. Bibby suggests, is dawning on the export industries. He goes on to say, however, that those who are in occupations not directly open to international competition, such as those engaged in public utilities and home services, still wish to bury their heads in the sand believing that they can extract an unduly high reward without impoverishing their fellow workers and ultimately themselves.

Many of the leaders of the great trade unions, Mr. Bibby thinks, realise this truth, but, he observes, it is difficult for them to "put it across," particularly to those who deliberately shut their eyes to unpleasant facts. Many of the industries, the statement continues, which used to provide the bulk of our exports now find that those goods are being made in the countries which used to buy from us. This, Mr. Bibby remarks, is inevitable in the general evolution of things, though it should not produce a feeling of pessimism or gloom. New industries are always springing up and new inventions superseding the older ones, and our genius and efforts should be directed into that sphere rather than in trying to compete in fields where our old-time customers can produce for themselves at a cost well below our figure. We must, Mr. Bibby urges, always be one step ahead of our competitors and ready by flexibility to turn over production in order to exploit our advantage to the utmost.

Everyone, Mr. Bibby goes on to say, who has the required intelligence should become a skilled worker, as the unskilled worker produces little more than his unskilled brother abroad and, economically, does not earn any higher standard of living. The old apprentice principle must be increased and encouraged so that the vast majority of the population of these islands become skilled craftsmen, capable of producing high-grade goods which are beyond the capabilities of their less skilled competitors. In engineering in all its many branches, in farming, and in practically every trade, science and mechanisation demand from those engaged in such industries a much higher degree of study, knowledge and application than ever before. The sellers' market has gone, Mr. Bibby adds, and the buyer now demands prompt delivery and good workmanship, but only at a price that will win us the contract in the face of ever-growing international competition.

A Conference for Small Firms

The British Institute of Management, in co-operation with the National Union of Manufacturers and the Institute of Industrial Administration (Birmingham Centre), is arranging a week-end conference for small firms. It is to be held at Ashorne Hill, near Leamington Spa, from Friday evening, February 13th, to Sunday midday, February 15th, the general theme being "Making the Most of Limited Resources."

In announcing this conference, the British Institute of Management says that studies of the operations of smaller businesses have tended to show that their problems differ both in degree and kind from those of the larger organisations. Though 92 per cent of the businesses in Great Britain employ less than 250 people, they represent, in total, a very substantial part of the nation's productive resources. The problem of a large number of businesses at present, the Institute says, is that of maintaining liquid resources sufficiently big to enable them to function efficiently and to take advantage of favourable opportunities and up-to-date developments. Full account has been taken of that problem in selecting the theme for the forthcoming conference. At the various sessions the discussions will deal with such matters as "The Place of the Small Firm in the National Economy," "Balancing Liquid Resources and Requirements Under Present Conditions," "Conserving Resources Through Efficient Production Management," "Getting the Best Out of People," and "Security or Maximum Profit."

Improved Trade in S. England

At a meeting of the London and South-Eastern Regional Board for Industry, which took place last week under the chairmanship of Sir John Buchanan, it was reported that trading conditions within the region continued to improve slowly. It was stated that discussions with individual firms had shown that the improvement was coupled with keen competition both in the home and overseas markets. Most industrialists felt restrained optimism about the future, and did not think the keener competition altogether a bad thing; it tended to eliminate goods that were not of a high standard of quality and also stimulated efficiency in methods of production. During the meeting it was stated that applications for industrial building licences and development certificates showed signs of increasing. Raising the free limit for industrial premises to £2000 from the beginning of this year was not expected to result in a very marked decrease during the coming months, as the Board of Trade felt that the drop in applications due to the bigger free limit might well be offset by an increase in applications for projects above £2000.

Notes and Memoranda

Air and Water

PREFABRICATED FRIGATE.—All-welded, anti-submarine frigates, planned for rapid construction by prefabrication methods, are being built by various shipbuilders for the Royal Navy. The first prefabricated section of this class of vessel has been laid down recently at the Birkenhead yard of Cammell Laird and Co., Ltd.

"COMET" ORDERS.—A recent order from Panair do Brasil for four Series 2 "Comet" aircraft brings the total of firm orders for all series of this aircraft to forty-six. In addition, orders for more than 100 of the Series 2 and 3 aircraft are under active discussion, many of them in an advanced stage of contract negotiation.

Rail and Road

CORRECTION.—In the article "Shunting Locomotives for South African Railways," which appeared in the issue of December 26, 1952, it was incorrectly stated that the locomotives had boilers of welded construction. The locomotives have boilers of riveted construction and welded fireboxes.

FRENCH HONOUR FOR MR. JOHN ELLIOT.—Mr. John Elliot, chairman of the Railway Executive and vice-president of the International Union of Railways, has been nominated an Officer of the Legion of Honour, in recognition of the part he has played in the development of international services between France and Great Britain, and in the promotion of co-operation between their two railway systems.

VEHICLE BUMPERS.—A heavy-duty reinforced rear bumper, incorporating a step and curved around the corners of the body, is now being supplied by Smith Electric Vehicles, Ltd., Gateshead-on-Tyne, 11. These bumpers closely follow the lines preferred in Canada and the United States. They are particularly suitable for the American practice of pushing bumper to bumper, instead of towing, and, where necessary, clearing parking places by the same method. The bumpers are designed to suit specific dimensions of body and chassis, and can be supplied in steel or aluminium alloy. They are of welded construction and covered in chequer plate.

Miscellanea

SELLING PRICE FOR TUNGSTEN ORE.—The Ministry of Materials has announced that as from January 8th its selling prices for tungsten ores of standard 65 per cent grade and ordinary quality have been reduced as follows: Wolframite from £21 12s. 6d. to £19 12s. 6d., and scheelite from £21 2s. 6d. to £19 2s. 6d. per long ton unit, delivered consumers' works.

NICKEL PRICE.—The Mond Nickel Company, Ltd., announces that, following the announcement in Canada by the International Nickel Company of Canada, Ltd., of an increase in the price of nickel effective from January 14th, it has, as from the same date, raised its price for refined nickel in the United Kingdom to £483 per ton, delivered works, with appropriate increases for other countries.

THE LATE MR. COLIN LAYCOCK.—We have learned with regret of the death, on January 7th, of Mr. Colin Laycock, president of J. Beardshaw and Son, Ltd., Baltic Steel Works, Sheffield. Mr. Laycock, who was seventy-three, had been associated with the firm for fifty-eight years. He was appointed a director in 1911, joint managing director in 1916, and chairman and managing director in 1936.

CEMENT PRODUCTION IN 1952.—The Cement Makers' Federation says that for the fifth successive year total deliveries of cement in the home and export markets set up new records in 1952. Home deliveries amounted to 9,147,000 tons, which was 12·3 per cent more than in 1951. Exports also made a new record at 2,055,000 tons, an increase of 4 per cent over 1951. New capacity of some 500,000 tons will be available in the present year.

ROYAL ORDNANCE FACTORIES BOARD.—The Ministry of Supply announces that Mr. A. G. E. Briggs, who relinquished the post of Deputy Controller of Supplies (Munitions Production) on January 1st, has consented to remain on the Royal Ordnance Factories Board of Management as an additional non-official member. Mr. Briggs, who has served on the Board since it was created in April, 1952, has recently resumed his duties with Tube Investments, Ltd.

CONFERENCE FOR FOREMEN AND SHOP STEWARDS.—The Industrial Welfare Society is organising a week-end conference for foremen and shop stewards on the subject of "Human Relations and Productivity on the Shop Floor." The conference will be held from Friday to Monday, February 20th to 23rd, at the Oulton Hall Hotel, Clacton-on-Sea, Essex. Full particulars of it can be obtained from the Industrial Welfare Society, 48, Bryanston Square, London, W.1.

THE I.E.E. FARADAY LECTURE.—The Faraday Lecture of the Institution of Electrical Engineers will be given at the Central Hall, Westminster, on Wednesday, February 18th, at 6.30 p.m., admission being by tickets obtainable from the secretary, the Institution of Electrical Engineers, Savoy Place, London, W.C.2. The lecturer will be Mr. A. R. Cooper (Controller, North Western Division, British Electricity Authority), and his subject will be "Light from the Dark Ages, or the Evolution of Electricity Supply."

METALLURGY CONFERENCE.—The Department of Industrial Metallurgy, University of Birmingham, is arranging its annual two-day conference this year for Monday and Tuesday, March 16th and 17th. The subjects will be "The Deep Drawing of Metals" on the first day and "Continuous Casting of Ingots" on the second. Full details of the programme may be obtained from the Secretary, Department of Industrial Metallurgy, The University, Edgbaston, Birmingham, 15. No fees are chargeable for attendance at the conference, but registration is required.

COAL PRODUCTION.—The output of coal in Great Britain last week amounted to 4,553,000 tons, of which 4,347,200 tons came from the deep mines and 205,800 tons from opencast workings. Production in the comparable week of last year was 4,594,900 tons, which was made up of 4,407,100 tons from the deep mines and 187,800 tons of opencast. In the week ended January 3rd there were 720,700 wage earners on colliery books, 299,000 of whom were face workers. At the beginning of January last year there were 699,700 on the books, which figure included 287,000 face workers. The latest figure for coal stocks relates to January 3rd. They then totalled 15,984,000 tons, compared with 15,538,000 tons a year ago.

SYMPOSIUM ON BURSTING DISCS.—A symposium on "Bursting Discs," organised by the Institution of Chemical Engineers, was presented at Caxton Hall, Westminster, on Tuesday last, January 13th. The papers included:—"Bursting Disc Assembly for Alternating Pressure and Vacuum at Elevated Temperature," by Mr. E. A. K. Patrick; "Bursting and Isolating Discs in Chemical Plant," by Mr. F. Molyneux; "Bursting Disc Design and Application in the Chemical Industry," by Mr. D. J. Breeze; "Tubular Bursting Elements," by Mr. W. R. D. Manning; "The Design and Manufacture of Bursting Disc Assemblies," by Mr. J. M. Pirie and Mr. J. F. W. Brown; and "The Use of Ductile Metals for Bursting Discs," by Mr. T. B. Philip.

"CONTROPOL" JOINTING COMPOUND.—We have received particulars of a jointing compound suitable for a wide field of application which is now being marketed by Stanley and Sanders, Ltd., 34, West Common Road, Hayes, Kent. This compound, known as "Contropol," is supplied ready for use in the form of a thick fluid and is easily applied without any additional packing material, directly to the surfaces to be joined. Joints made with the compound are claimed to withstand effectively water pressures of up to 3000 lb per square inch, withstand temperatures from 1000 deg. to 50 deg. Cent. below freezing point, and to be stable in petrol, oil, acids, alkalis and steam. A number of interesting tests are quoted by the suppliers to substantiate these claims for the compound in plant service.

OIL EXHIBITION.—On Tuesday, January 13th, the Kuwait Oil Company, Ltd., held an "Oil in Kuwait" exhibition at the Royal Society of Arts, 6, John Adam Street, London, W.C.2. The exhibition represents the story of a major development in the oil-producing industry and tells, in photographic form, the post-war achievement of the company in the Shaikdom of Kuwait. In three main sections the exhibition traces the story, showing the town of Kuwait and something of its people and their activities. Other photographs illustrate surveying, oil drilling, pipeline laying and other work connected with oil development, while there are views of the new town of Ahmadi, the loading jetty at Mina al Ahmadi, together with illustrations of the local refinery and the 700,000 gallons per day distillation plant.

ALUMINIUM MINING EQUIPMENT.—A brochure entitled "Aluminium Mining Equipment" has been published by the Northern Aluminium Company, Ltd., and in its pages are described the variety of applications of light alloy to colliery equipment. The case for each application is stated and details are recorded of past and present service. Following a brief review of the position of aluminium in the field of mining there are general notes upon the company's alloys used. Under the heading "Roof Control" a section of the brochure discusses the advantages to be gained and the fittings used for this purpose, including screw-jack props, bent bars, hollow beams for gate end supports. Handling of coal is reviewed and the use of aluminium for conveyors, tubs and cars, cages and skips for this work is examined while in the next section examples of aluminium tools are given. These include such items as powered picks and drills, drill stands, anchor props and cutter derricks, sylvesters, lifting jacks and others. Mention is made of electrical equipment and, lastly, the question of the maintenance and repair of aluminium equipment is discussed and notes are given on the working of the metal, methods of jointing and of painting.

AUSTRALIAN ENGINEERS' TRAINING COURSE.—This week four young graduate engineers from Australia have arrived in London in connection with the Federation of British Industries overseas scholarships scheme. Through this scheme, which is a long-term plan for British exports, it is hoped eventually to train every year in British engineering works from 150 to 250 selected graduates from developing countries overseas. The four Australian engineers will be followed in the next few weeks by seven others who have also been recommended for F.B.I. scholarships by special selection committees in Australia. The four who have arrived are Mr. M. S. Gregory, a civil engineer from Tasmania, who is to receive training with Sir Alexander Gibb and Partners, London; Mr. I. Buchan, an electrical and mechanical engineer from New South Wales, who is going to the Fairey Aviation Company, Ltd., Hayes, Middlesex; Mr. G. J. Campbell, an electrical and mechanical engineer from Victoria, who is going to Fraser and Chalmers Engineering Works, Erith, Kent; and Mr. R. H. Casling, from South Australia, who is going to Glenfield and Kennedy, Ltd., Kilmarnock. All graduates normally receive two years' practical training in Britain. Training and maintenance expenses will be defrayed by British industry, aided by a grant from the Government and, in some cases, by the overseas Government concerned.

Personal and Business

MR. R. H. HEMMINGS, a director of York Shipley, Ltd., has been appointed chairman of the British Refrigeration Association.

BURTON GRIFFITHS AND CO., Ltd., states that its Leeds branch office has been moved to 27A, Butts Court, Leeds, 1 (telephone, Leeds 34251).

MAVOR AND COULSON, Ltd., Bridgeton, Glasgow, states that Mr. J. D. Lloyd, general sales manager, has been appointed a director.

MR. G. W. BONE, works director of Davey, Paxman and Co., Ltd., Colchester, has been appointed assistant managing director of the company.

DUNLOP, Ltd., announces the retirement of Mr. David Cairns, district manager for tyres in Belfast. He is succeeded by Mr. G. C. K. Pinnell.

THE MINISTRY OF FUEL AND POWER states that its information branch has been transferred to Thames House South, Millbank, London, S.W.1.

MATTHEW HALL AND CO., Ltd., 26–28, Dorset Square, London, N.W.1, announces the retirement of Mr. F. J. Bell, who has been in the company's service for thirty-five years.

G. AND J. WEIR, Ltd., Cathcart, Glasgow, announces the retirement of Mr. C. A. Packer, who has been responsible for apprentice training for more than thirty years.

MR. W. J. WORBOYS, a director of Imperial Chemical Industries, Ltd., has been appointed chairman of the Council of Industrial Design in succession to Dr. R. S. Edwards.

THE PENINSULAR AND ORIENTAL STEAM NAVIGATION COMPANY announces that Captain A. Rodger has been appointed as marine superintendent upon the retirement of Captain E. M. Coates, C.B.E., R.N.R.

WICKMAN, Ltd., Coventry, states that its subsidiary company, Applied High Frequency, Ltd., has now been incorporated as a division of the main company under the title Wickman, Ltd., Applied High Frequency Division. Its address is Actarc Works, Goldhawk Road, London, W.12.

METROPOLITAN-VICKERS ELECTRICAL COMPANY, Ltd., Trafford Park, Manchester, announces the following appointments:—Mr. J. P. A. Meldrum, M.I.E.E., manager, home sales; Mr. A. E. Grimsdale, B.Sc. (Eng.), special assistant, sales management, and Mr. J. C. Way, A.M.I.E.E., sales manager, traction department.

MR. R. B. SIMS, A.M.I.Mech.E., head of the rolling laboratory of the British Iron and Steel Research Association since 1948, has relinquished that appointment to become research manager of Davy and United Engineering Company, Ltd., Sheffield. For an agreed period he will continue to act as consultant to the B.I.S.R.A. rolling laboratory.

MR. R. R. C. RANKIN, A.M.I.E.E., a director of Mullard Equipment, Ltd., has been appointed a director of Telcon Telecommunications, Ltd., in place of Dr. C. F. Bareford, who has resigned from the board following his appointment as chief superintendent of the Long Range Weapons Establishment at Salisbury and Woomera, South Australia.

MR. H. J. ROWE has relinquished, for health reasons, his position as managing director of the Newall Engineering Company, Ltd., Old Fletton, Peterborough. He will continue as a director of the company and as managing director of Optical Measuring Tools, Ltd. Mr. Sydney Player and Mr. J. C. Player have been appointed joint managing directors of the Newall Engineering Co., Ltd.

Contracts

CHEMICAL ENGINEERING WILTONS, Ltd., a member company of the Simon Engineering Group, has received two contracts for new tar distillation plants for the National Coal Board. The first plant was ordered in the early part of last year by the East Midlands Division for construction at the new Avenue coke oven site near Chesterfield. It will comprise a Wilton continuous tar distillation plant with an initial capacity of 200 tons per day, together with ancillary plant for hard pitch, tar acid concentration, naphthalene and anthracene production, blending for road tars and pitch creosotes. More recently the South-Western Division of the Coal Board has placed an order for a Wilton continuous distillation plant in connection with the tar works at Caerphilly. This plant will treat 150 tons of tar per day, derived from new coke oven installations in South Wales

British Patent Specifications

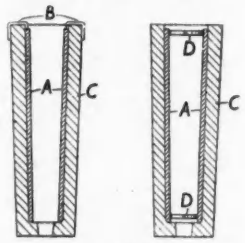
When an invention is communicated from abroad the name and address of the communicator are printed in italics. When an abridgment is not illustrated the specification is without drawings. The date first given is the date of application; the second date, at the end of the abridgment, is the date of publication of the complete specification.

Copies of specifications may be obtained at the Patent Office Sales Branch, 15, Southampton Buildings, Chancery Lane, W.C.2, 2s. 8d. each.

METALLURGY

683,330. August 29, 1950.—THE PRODUCTION OF STEEL INGOTS, Richard Thomas and Baldwins, Ltd., 47, Park Street, London, W.1; and Andrew Agnew, jun., Eastridge, Derwen Fawr Road, Swansea; and Derek Arthur Bishop, 58, Hawthorne Avenue, Swansea.

The invention relates to the production of composite steel ingots and its chief object is to evolve a process whereby ingots may be produced consisting of a mild steel core with one or more outer surfaces of stainless steel. The thickness of the stainless steel plates *A* selected may be varied and depend upon the thickness of the stainless steel coating required. As shown in the left-hand view, each plate *A* is held by brackets *B* which are welded



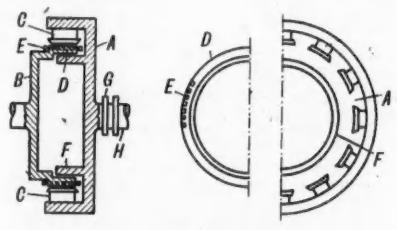
No. 683,330

to it and are hooked over the lip of the ingot mould *C*. After the ingot is cast the supporting brackets are burnt off. In the right-hand view the plates *A* are held flat against the mould faces by means of two retaining or wedge members in the form of steel hoops *D*, which are of similar composition to the liquid mild steel to be poured. As indicated, one hoop is located at the bottom and the other at the top of the mould. With the plates in position in the mould liquid mild steel is then poured to form the internal body of the ingot. The mild steel should have a silicon content of from 0·1 per cent to 0·5 per cent and preferably also a carbon content of up to 0·2 per cent. The stainless-steel-clad ingot produced in accordance with the invention may subsequently be rolled into any desired shape or product which will in turn be stainless steel clad.—*November* 26, 1952.

ELECTRICAL ENGINEERING

683,581. December 18, 1950.—ELECTROMAGNETIC SLIP COUPLINGS, Allmanna Svenska Elektriska Aktiebolaget, Vasteras, Sweden.

The object of the invention is to provide a construction for electromagnetic slip couplings which considerably reduces the moment of inertia of the secondary member. Referring to the drawing, the electromagnetic slip coupling illustrated comprises a primary member *A* and a secondary member *B*. The primary member comprises poles *C* of alternate polarity, excited by primary windings and the secondary member comprises an armature *D* which has a radial thickness less than that required for the magnetic flux. In the example shown the armature



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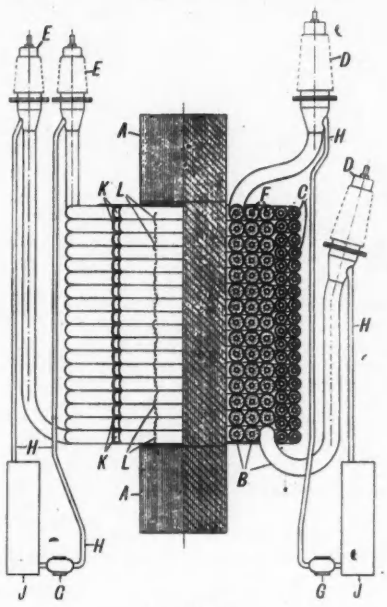
supports secondary windings *E*, which may be squirrel cage or polyphase windings. The primary member supports an iron ring *F* lying as close as possible to the inner surface of the armature *D* to compensate for the deficit in thickness of the armature iron. Slip rings *G* are mounted on the primary shaft for supplying excitation current to the windings of the poles. In the embodiment shown, the poles, the armature and the iron ring are so arranged that the magnetic flux through the air gap is directed radially. It is, however, also possible to so arrange these parts within the primary member that the flux is directed axially. In this case the armature and the additional iron ring are in the form of discs. In addition to reducing the moment of inertia of the secondary member, the construction gives the further advantage that the magnetic radial pull of the slip coupling is reduced to a minimum.—*December* 3, 1952.

683,657. January 3, 1951.—ELECTRIC TRANSFORMER FOR HIGH POWER AND HIGH TENSION, Giuseppe Scarpa, 9, Viale Bianca Maria, Milan, Italy.

The invention relates to electric transformers, in which the primary and secondary windings are formed by a cable provided with a metallic sheathing. The drawing shows the transformer diagrammatically, partly in elevation and partly in section. *A* is the magnetic core and *B* the cable forming the higher tension winding, and *C* the cable forming the lower



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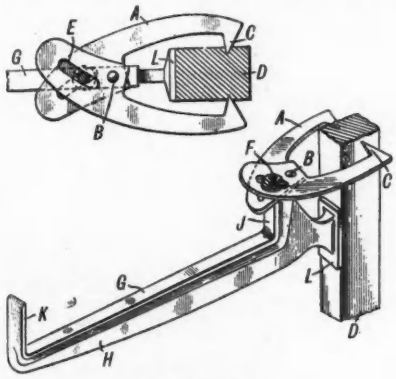
tension winding. *D* denotes the terminal high-tension insulators and *E* the terminal low-tension insulators. Oil is circulated in the hollow bore *F* of the tubular conductors forming the core of the cables *B* and *C* to disperse the heat evolved in the winding. Oil is circulated through the pumps *G* connected by conduits *H* to the ends of each winding. Heat exchangers *J* are interposed in the oil circuits. *K* denotes interruptions in the metal cable sheathing at each turn, and *L* the equipotential connections between the various sections of the metal cable sheathing.—*December* 3, 1952.

STRUCTURAL ENGINEERING

684,198. November 1, 1950.—SCAFFOLD SUPPORT, Louis Normandeau, 5291, Marquette Street, City of Montreal, Province of Quebec, Canada, and Stuart Gilbert Steele, 35, Brunet Avenue, Pointe Clare, Quebec, Canada.

As shown in the accompanying drawings, the clamping portion of the device comprises a pair of jaws *A* pivoted to each other by a pin *B*. The end of each arm at one side of the fulcrum is formed



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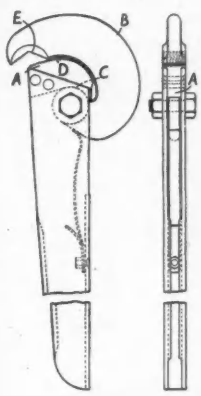
with an inward-directed point or prong *C*. These prongs are directed in order to bite into a wooden post *D*, which may be temporary or a part of a building. At the other side of the fulcrum, each lever is formed with a curved slot *E*, the two slots crossing each other. A stub shaft *F* passes through both slots and carries washers at both surfaces of the levers, the upper washer being held down by a nut. The shaft *F* is an integral part of a horizontal supporting arm *G* which has a rib *H* and upturned ends *J* and *K*. The top of the end *J* retains the lower washer. From this arm also extends a finger carrying a plate *L* which bears against the post D. The body of the arm *G* carries the load. A series of such devices can be used to support a plank. The levers *A* are initially adjusted to engage the post. The load on the arm tends to move it downward and cause the plate *L* to act as a pivot, moving the shaft *F* slightly away from the post. The actual movement is slight but the pressure in the directions indicated is important. The movement of the shaft within the slots *E* swings the pointed ends of the jaws toward each other and increases the pressure and grip on the post. Thus, the greater the load on the device the firmer is its grip on the post.—*December* 10, 1952.

TOOLS AND WORKSHOP APPLIANCES

684,240. October 18, 1949.—IMPROVED WRENCHES, John Henry Edgar Davis, Orchard House, Prudhoe Station, Prudhoe, Northumberland, and F. L. Wraight and Co., Ltd., Vulcan Works, Mucklow Hill, Halesowen, Birmingham.

According to the invention, the wrench comprises a hand lever formed as a mild steel pressing, channel-shaped in cross-section, the back of the channel being removed at the inner end of the hand lever to form two side cheeks. An inner gripping jaw *A* consisting of a hardened steel block, is fixed to the inner end of the lever by means of rivets or bolts. An outer gripping jaw *B* in the form of a "C"-shaped arm is pivotally mounted on the hand lever. The inner edge of the inner gripping jaw has a recess in it having a surface which is also concentric with the pivot axis of the outer jaw, and this surface forms an abutment surface against which the boss or knuckle *C* bears and against which it is held in position by means of the shank of the pin in the boss and cheeks. The outer portion of the outer gripping jaw extends over the gripping face *D* of the inner jaw and the outer end of this outer portion of the jaw has a dihedral angle recess *E* for receiving the article to be gripped, so that it is always gripped in one position in relation to the outer jaw. One face of the recess is toothed and the gripping face of the inner jaw *C* is shaped so that when the jaws are opened the two gripping faces are opposite throughout a large angle of opening of the jaws. The spring applies the initial gripping pressure.—*December* 17, 1952.

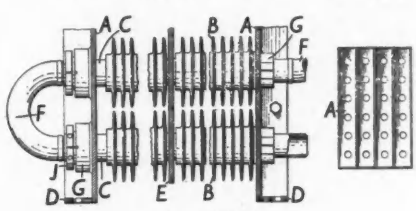


No. 684,240

HEAT EXCHANGERS

684,524. November 6, 1950.—TUBULAR HEAT EXCHANGERS, E. Green & Son, Ltd., Economiser Works, Wakefield, Yorkshire. (*Inventor: Cyril Wright Parris.*)

The invention relates to tubular heat exchangers such as economisers or other tubular heat exchange apparatus where it is required to provide considerable heat absorption capacity in a confined space with minimum weight. In the example shown in the drawings, in place of the usual flat metal tube plates



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a series of light pressed or fabricated metal end plates *A* are employed, each having clearance holes for the tube ends and being only slightly wider than the extended surfaces *B* on the tubes *C*. The plates are provided at the sides with flanges and at the ends with flanges *D* by which the end walls of a heat exchanger may be fastened together, the flanges acting at the same time as stiffening ribs. Each individual plate is made to receive a number of

tubes one above the other and an intermediate support plate *E* for the tubes may be provided if necessary. The ends of adjacent tubes are connected by bends *F*. The tubes *C* are provided with gilled sleeves *B* and making up pieces at one end, these ends being fixed or anchored to the plates by securing collars *G* on the tubes outside the plates. The collars are formed in halves and clamped together on the tubes by screws, or by collars welded to the tubes as set forth in Specification No. 583,140. The other ends of the tubes can slide in the plates in a gas-tight manner, being held by a packing gland, a split collar being located around the tube to maintain the packing gland in compression. In this way a series of sections can be built up and may be arranged with the tube rows in a vertical plane, or at 60 deg. inclination in accordance with the commonly used equilateral tube pitching, or at any other convenient angle. With the construction described a complete welded section may be withdrawn simply by cutting off the top and bottom connector bends.—*December* 17, 1952.

Launches and Trial Trips

SIRRAH, oil tanker; built by the Netherlands Dock and Shipbuilding Company, for N.V. van Nievelt Gondriaan and Co.; length between perpendiculars 532ft 6in, breadth moulded 72ft 9in, depth 38ft 3in, deadweight 18,500 tons, load draught 29ft 6in, speed 15·25 knots; Stork double-acting, two-stroke diesel engine, seven cylinders, 7500 b.h.p. at 118 r.p.m., two Scotch boilers, two 225kW diesel generators. Launch, December 20th.

HAROLD SLEIGH, oil tanker; built by Blythswood Shipbuilding Company, Ltd., for the Singapore Navigation Company, Ltd.; length between perpendiculars 460ft, breadth 61ft, depth moulded 34ft 1in, deadweight 12,600 tons on 27ft 6in draught; twenty-seven cargo oil tanks, two pump rooms, four 270 tons per hour cargo oil pumps; Kincaid B. and W. single-acting, four-stroke, diesel engine, six cylinders 740mm diameter by 1500mm stroke, 3600 b.h.p., two horizontal multi-tubular boilers. Trial, December 29th.

VIET NAM, passenger liner; built by the Chantiers Navals de La Ciotat for the Compagnie des Messageries Maritimes; length between perpendiculars 488ft 1in, breadth 72ft 2in, depth 43ft 10in, load draught 25ft 6in, deadweight 6580 tons; 539 passengers including 117 first and 110 tourist class; two sets of geared Rateau-Bretagne turbines developing 19,500 s.h.p. in service and taking steam from three P.41 Penhoët boilers at 62kg per square centimetre and 480 deg. Cent., four 700kW diesel-driven generators. Trial, December.

Forthcoming Engagements

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of their insertion, the necessary information should reach this office on or before the morning of the Monday of the week preceding the meetings. In all cases the TIME *and* PLACE *at which the meeting is to be held should be clearly stated.*

BRITISH INSTITUTION OF RADIO ENGINEERS

Tues., Jan. 27th.—W. MIDLANDS SECTION: Technical College, Wulfruna Street, Wolverhampton, "The Search for Bandwidth Economy in Television," D. A. Bell, 7.15 p.m.

CHEMICAL SOCIETY

Thurs., Jan. 22nd.—LONDON BRANCH: Burlington House, Piccadilly, London, W.1, "Discoveries among Conjugated Macrocyclic Compounds," R. P. Linstead, 7.30 p.m.

CLEVELAND INSTITUTION OF ENGINEERS

Tues., Jan. 20th.—Cleveland Scientific and Technical Institution, Corporation Road, Middlesbrough, "Organising and Commissioning the New Rolling Mills of the Steel Company of Wales, Ltd.," H. Ascough, Film, "The First Four Years," 6.30 p.m.

ENGINEER BUYERS AND REPRESENTATIVES ASSOCIATION

To-day, Jan. 16th.—LONDON AND HOME COUNTIES BRANCH: "The Cranbourne," Upper St. Martin's Lane, W.C.2, Film, "Monte Carlo Rally," 7 p.m.

HULL CHEMICAL AND ENGINEERING SOCIETY

Tues., Jan. 27th.—Church Institute, Albion Street, Hull, "Silicones and Their Industrial Uses," N. H. Collings, 7.30 p.m.

ILLUMINATING ENGINEERING SOCIETY

Wed., Jan. 21st.—N. LANCASHIRE GROUP: Chamber of Commerce, 49a, Fishergate, Preston, "The Contractor Sheds Some Further Light," F. Ainscow, 7.15 p.m.——TEES-SIDE GROUP: Cleveland Scientific and Technical Institution, Corporation Road, Middlesbrough, "Light in the Aid of Crime Detection," C. H. Edlin, 6.30 p.m.

Mon., Jan. 26th.—LEEDS CENTRE: Lighting Service Bureau, 24, Aire Street, Leeds, 1, "The Physical Principles Governing Fittings Design," W. H. Willott, 6.15 p.m.——LEICESTER CENTRE: E. Midlands Electricity Board, Charles Street, Leicester, "Automobile Lighting," K. J. Jones, 6.30 p.m.

Tues., Jan. 27th.—CARDIFF CENTRE: S. Wales Electricity Board, Cardiff, "Stagelighting," L. G. Applebee, 5.45 p.m.——LIVERPOOL CENTRE: Merseyside and N. Wales Electricity Board's Service Centre, Whitechapel, Liverpool, 1, "Black Light, its Effect and Application," H. L. Privett, 6 p.m.

Wed., Jan. 28th.—SWANSEA GROUP: Minor Hall, Y.M.C.A., Swansea, "Coloured and Directional Light as Applied to the Stage," L. G. Applebee, 6 p.m.——LONDON MEETING: Trotter-Paterson Memorial Lecture: Royal Institution, Albemarle Street, London, W.1, "The Nervous Reactions of the Retina," E. D. Adrian, 6 p.m.

Thurs., Jan. 29th.—BRADFORD GROUP: Yorkshire Electricity Board, 45–53, Sunbridge Road, Bradford, "Lighting for Celebrations," A. D. Charters, 7.30 p.m.

INCORPORATED PLANT ENGINEERS

To-day, Jan. 16th.—BIRMINGHAM BRANCH: Imperial Hotel, Temple Street, Birmingham, Contractors' Plant Discussion Group, 7.30 p.m.

Tues., Jan. 20th.—GLASGOW BRANCH: Engineering Centre, 351, Sauchiehall Street, Glasgow, "Insulation of Buildings" A. G. Sutton, 7 p.m.——HERTFORDSHIRE DISCUSSION GROUP: Peahen Hotel, St. Albans "Colour in Industry," R. E. Wilson, 7.30 p.m.

Wed., Jan. 21st.—KENT BRANCH: Bull Hotel, Rochester, "Free Piston Engines," P. R. Watson, 7 p.m.——WESTERN BRANCH: Grand Hotel, Bristol, "The Approach to Maintenance," Discussion, 7.15 p.m.

Thurs., Jan. 22nd.—W. AND E. YORKS BRANCH: Great Hall, The University, Leeds, "Can There be a National Fuel Policy," Oliver Lyle, 7.30 p.m.

Mon., Jan. 26th.—W. AND E. YORKS. BRANCH: The University, Leeds, Film, "Basic Principles of Lubrication," 7.30 p.m.

Thurs., Jan. 29th.—S. YORKSHIRE BRANCH: Grand Hotel, Sheffield, Film, "Oxygen in Industry," and Liquid Oxygen Demonstration, 7.30 p.m.

INSTITUTE OF BRITISH FOUNDRYMEN

Wed., Jan. 28th.—Waldorf Hotel, Aldwych, London, W.C.2, "Runners and Risers," Three Short Papers, E. D. Daybell, P. A. Russell and R. W. Ruddle, 7.30 p.m.

INSTITUTE OF ECONOMIC ENGINEERING

Fri., Jan. 23rd.—Engineers Club, Albert Square, Manchester, "The Industrial Application of Dyes," F. Parrott, 7 p.m.

INSTITUTE OF FUEL

Tues., Jan. 27th.—Institution of Mechanical Engineers, Storey's Gate, St. James's Park, London, S.W.1, "Efficiency of Domestic Space-Heating Appliances using Solid Fuel," L. L. Fox, 5.30 p.m.

INSTITUTE OF MARINE ENGINEERS

Wed., Jan. 21st.—Technical College, Swansea, "Construction of Marine Boilers," A. P. Monk, 7 p.m.

Thurs., Jan. 22nd.—Technical College, Kingston, "Construction of Steam Turbines" J. Brown, 2.30 p.m.

Wed., Jan. 28th.—Technical College, Gravesend, "Photo-Elasticity," J. Ward, 7 p.m.

Thurs., Jan. 29th.—Technical College, Barrow-in-Furness, "Construction of Marine Boilers," A. P. Monk, 7.30 p.m.

INSTITUTE OF NAVIGATION

To-day, Jan. 16th.—Royal Geographical Society, 1, Kensington Gore, London, S.W.7, "Radar and Ice," L. S. Le Page and A. L. P. Milwright, 5 p.m.

INSTITUTE OF PETROLEUM

Wed., Jan. 28th.—26, Portland Place, London, W.1, "Geophysics—Its Problems and Trends," D. T. Germain-Jones, 5.30 p.m.

INSTITUTE OF REFRIGERATION

Tues., Jan. 20th.—Institution of Mechanical Engineers, Storey's Gate, St. James's Park, London, S.W.1, "The Freezing, Chilling and Cold Storage of Meat," E. C. Bate-Smith and Putnam Eaton, 5.30 p.m.

INSTITUTE OF ROAD TRANSPORT ENGINEERS

Tues., Jan. 20th.—N.E. OF ENGLAND GROUP: King's Head Hotel, Prebend Row, Darlington, "P.S.V. Maintenance," E. C. Tuff, 7 p.m.

Wed., Jan. 21st.—N.W. CENTRE: Victoria Hotel, Wigan, "Rear Axles," R. H. Wilson, 7.30 p.m.——LONDON CENTRE: Royal Society of Arts, John Adam Street, London, W.C.2, "Organisation for the Maintenance of a Large Fleet," J. W. Taylor, 6.30 p.m.

INSTITUTION OF BRITISH AGRICULTURAL ENGINEERS

Wed., Jan. 21st.—Institution of Electrical Engineers, Savoy Place, London, W.C.2, "Recent Design and Development of Milking Machines," H. S. Hall, 2.15 p.m.

INSTITUTION OF CHEMICAL ENGINEERS

Sat., Jan. 31st.—MIDLANDS BRANCH: The University, Edmund Street, Birmingham, Annual General Meeting, "The Treatment of Waste Gases in Chemical Industry," W. A. Damon.

INSTITUTION OF CIVIL ENGINEERS

Tues., Jan. 20th.—ORDINARY MEETING: Great George Street, Westminster, London, S.W.1, "Claerwen Dam: Design and Construction of a 200ft High Gravity Dam for Birmingham Water Department," P. A. Scott, R. J. C. Walton, R. H. Falkiner and H. D. Morgan, 5.30 p.m.

Fri., Jan. 23rd.—YORKSHIRE ASSOCIATION: Great Northern Station Hotel, Leeds, "The Acomb-Naburn Sewerage Scheme, York," C. J. Minter, 7 p.m.——MIDLANDS ASSOCIATION: James Watt Memorial Institute, Great Charles Street, Birmingham, "Recent Applications of Shell Concrete Construction in England and Wales," K. Hajnal Konyi, 6 p.m.

Tues., Jan. 27th.—RAILWAY MEETING: Great George Street, Westminster, London, S.W.1, "Design of Structures in Relation to Maintenance and Inspection," F. Turton and N. S. Cox, 5.30 p.m.

INSTITUTION OF ELECTRICAL ENGINEERS

Mon., Jan. 19th.—INFORMAL MEETING: Savoy Place, London, W.C.2, Discussion on "The Parallel Running of Private Generating Plant with the Grid System," opened by E. R. Wilkinson, 5.30 p.m.

Tues., Jan. 20th.—MEASUREMENTS SECTION: Savoy Place, London, W.C.2, Discussion on "Measurements of Magnetic Permeability," opened by A. J. King, 5.30 p.m.——N. MIDLAND CENTRE: British Electricity Authority, 1, Whitehall Road, Leeds, 1, "Electricity in Newspaper Printing," A. T. Robertson, 6.30 p.m.——S.W. SCOTLAND SUB-CENTRE: Institution of Engineers and Shipbuilders, 39, Elmbank Crescent, Glasgow, C.2, "A Logical Approach to the Problems of Electrical Space Warming," D. H. Parry, 7 p.m.

Wed., Jan. 21st.—EDUCATION DISCUSSION CIRCLE: Savoy Place, London, W.C.2, Discussion on "Some Difficulties in the Teaching of Electrical and Mechanical Resonance," opened by C. T. Baldwin and J. C. Oakden, 6 p.m.——S.E. SCOTLAND SUB-CENTRE: Heriot Watt College, Edinburgh, "A Logical Approach to the Problems of Electrical Space Warming," D. H. Parry, 7 p.m.——SOUTHERN CENTRE: The University, Southampton, "Post Graduate Activities in Electrical Engineering," W. J. Gibbs, D. Edmunson, R. G. A. Dimmick and G. S. C. Lucas, 6.30 p.m.

Thurs., Jan. 22nd.—UTILIZATION SECTION: Savoy Place, London, W.C.2, Short Papers, "Hydrogen-Cooled Alternators," T. O. Jones; "The Evolution of Some Electromagnetic Machines," G. Campbell; "Electronic Control of Electrical Machines," N. G. Meadows, 5.30 p.m.

Mon., Jan. 26th.—RADIO SECTION: Savoy Place, London, W.C.2, Discussion on "The Relative Merits of Harmonic and Intermodulation Measurements in Assessing Distortion in Audio Equipment," opened by E. W. Berth-Jones, 5.30 p.m.

Wed., Jan. 28th.—SUPPLY SECTION: Savoy Place, London, W.C.2, "Some Researches on Circuit-Breaking by Means of High-Voltage Circuit Breakers, with Special Reference to Current-Chopping," A. F. B. Young, 5.30 p.m.

INSTITUTION OF ENGINEERING INSPECTION

Wed., Jan. 21st.—DUNDEE BRANCH: School of Economics, Bell Street, Dundee, "The Human Use of Human Beings," John D. Uytman, 7.15 p.m.

Thurs., Jan. 22nd.—N.W. BRANCH: Engineers' Club, Albert Square, Manchester, "Modern Inspection Methods," Mr. Ellerby, 7.30 p.m.

Wed., Jan. 28th.—W. OF SCOTLAND BRANCH: Engineering Centre, 351, Sauchiehall Street, Glasgow, C.2, Industrial Films, 7.30 p.m.

INSTITUTION OF ENGINEERS AND SHIPBUILDERS IN SCOTLAND

Tues., Jan. 27th.—39, Elmbank Crescent, Glasgow, C.2, "Production of Sound Castings by Controlled Rate of Heat Transfer," B. W. Payne and C. A. Parlanti, 6.30 p.m.

INSTITUTION OF MECHANICAL ENGINEERS

To-day, Jan. 16th.—Storey's Gate, St. James's Park, London, S.W.1, Discussion on "Control Valves for Direct-hydraulic Presses," F. H. Towler and J. M. Towler, 5.30 p.m.

Mon., Jan. 19th.—MIDLAND BRANCH GRADUATES' SECTION: James Watt Memorial Institute, Great Charles Street, Birmingham, "The Applications of Plastic Materials of Interest to Plant and Mechanical Engineers," S. J. Wooldridge, 7 p.m.

Tues., Jan. 20th.—N.W. BRANCH GRADUATES' SECTION: Engineers' Club, Albert Square, Manchester, "The Design and Application of Ball and Roller Bearings," H. Ligget, 6.45 p.m.

Thurs., Jan. 22nd.—WESTERN BRANCH: Grand Hotel, Bristol, Annual General Meeting, Chairman's Address, J. L. M. Morrison, 7 p.m.

Fri., Jan. 23rd.—Storey's Gate, St. James's Park, London, S.W.1, Discussion on "Design of Precision Grinding Machines," G. H. Asbridge, 5.30 p.m.

Wed., Jan. 28th.—E. MIDLANDS BRANCH: Conference Room, Peterborough Generating Station, British Electricity Authority, Peterborough, "The Measurement and Interpretation of Machinery Noise, with Special Reference to Oil Engines," C. H. Bradbury, 7.30 p.m.

Fri., Jan. 30th.—Storey's Gate, St. James's Park, London, S.W.1, Discussion on "Scale Formation in Sea-Water Distilling Plants and its Prevention," H. Hillier, 5.30 p.m.

INSTITUTION OF POST OFFICE ELECTRICAL ENGINEERS

Tues., Jan. 27th.—ORDINARY MEETING: Institution of Electrical Engineers, Savoy Place, London, W.C.2, "Co-axial Cables—Some Practical Aspects of Their Design and Maintenance," G. E. Rossiter, 5 p.m.

INSTITUTION OF STRUCTURAL ENGINEERS

Mon., Jan. 19th.—N. IRELAND BRANCH: College of Technology, Belfast, "Reinforced Concrete Building in Brazil," Harold E. Sidwell, 6.45 p.m.

Wed., Jan. 21st.—YORKSHIRE BRANCH: The University, Leeds, "Design of Prestressed Concrete," Donovan H. Lee, 6.30 p.m.

Thurs., Jan. 22nd.—11, Upper Belgrave Street, London, S.W.1, "Electricity Generating Stations," B. A. E. Hiley, 5.55 p.m.

Fri., Jan. 23rd.—MIDLAND COUNTIES BRANCH: James Watt Memorial Institute, Great Charles Street, Birmingham, "Recent Applications of Shell Concrete Construction in England and Wales," K. Hajnal-Konyi, 6 p.m.——S.W. COUNTIES BRANCH: Duke of Cornwall Hotel, Mill Bay, Plymouth, "Construction of Two Power Stations in the South-West," Leslie Richardson, 7 p.m.

Tues., Jan. 27th.—LONDON GRADUATES' AND STUDENTS' SECTION: 11, Upper Belgrave Street, London, S.W.1, Address by the President, 5.55 p.m.

Wed., Jan. 28th.—LANCASHIRE AND CHESHIRE BRANCH: Reynolds Hall, College of Technology, Manchester, "The Structural Design of the Mediæval Cathedral," Ronald Oates, 6.30 p.m.

Fri., Jan. 30th.—MIDLAND COUNTIES BRANCH: James Watt Memorial Institute, Great Charles Street, Birmingham, "Further Recent Midland Structures," 7 p.m.

JUNIOR INSTITUTION OF ENGINEERS

To-day, Jan. 16th.—Townsend House, Greycoat Place, London, S.W.1, "Statistics for Practical Engineers," S. J. Button.

Fri., Jan. 23rd.—Townsend House, Greycoat Place, London, S.W.1, "Cathodic Protection," W. Godfrey Waite, 7 p.m.

Sat., Jan. 24th.—N.W. SECTION: Geographical Society, 16, St. Mary's Parsonage, Manchester, "Hydro-Electric Schemes," F. Burgess, 2.30 p.m.

Fri., Jan. 30th.—Townsend House, Greycoat Place, London, S.W.1, "Metal Spinning," R. E. Baskerville, 7 p.m.

MANCHESTER ASSOCIATION OF ENGINEERS

Fri., Jan. 23rd.—Engineers' Club, Albert Square, Manchester, "Production of Modern Design Cars," E. W. Hancock, 6.45 p.m.

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS

Fri., Jan. 30th.—Bolbec Hall, Newcastle upon Tyne, 1, "Thickness of Tubes for Watertube Boilers," D. W. Crancher, 6.15 p.m.

ROYAL AERONAUTICAL SOCIETY

Tues., Jan. 27th.—GRADUATES' AND STUDENTS' SECTION: 4, Hamilton Place, London, W.1, "A Physical Interpretation of Supersonic Flow," R. Stanton Jones, 7.30 p.m.

Thurs., Jan. 29th.—Institution of Mechanical Engineers, Storey's Gate, St. James's Park, London, S.W.1, "Titanium—A Survey," P. L. Teed, 6 p.m.

ROYAL INSTITUTION OF CHARTERED SURVEYORS

Mon., Jan. 19th.—12, Great George Street, London, S.W.1, "The Predicament of Overgrown Towns," B. J. Collins, 5.30 p.m.

SHEFFIELD METALLURGICAL ASSOCIATION

Tues., Jan. 20th.—Grand Hotel, Sheffield, Annual General Meeting, 7 p.m.

SHEFFIELD SOCIETY OF ENGINEERS AND METALLURGISTS

Mon., Jan. 19th.—The University, St. George's Square, Sheffield, "The Application of the Diesel Engine and the Gas Turbine to Traction," G. H. Fletcher, 7.30 p.m.

SOCIETY OF CHEMICAL INDUSTRY

Tues., Jan. 20th.—CORROSION GROUP: Burlington House, Piccadilly, London, W.1, "The Electrochemical Behaviour of Metals and Corrosion," M. Pourbaix, 6.30 p.m.

SOCIETY OF INSTRUMENT TECHNOLOGY

Tues., Jan. 27th.—Manson House, Portland Place, London, W.1, "Instrumentation in the Paper-Making Industry," F. W. Hayward, 6.30 p.m.

WOMEN'S ENGINEERING SOCIETY

Wed., Jan. 28th.—MANCHESTER BRANCH: Engineers' Club, Albert Square, Manchester, "The Projection of Microscopic Structures," W. J. Garnett, 6.30 p.m.